March/April, 1977
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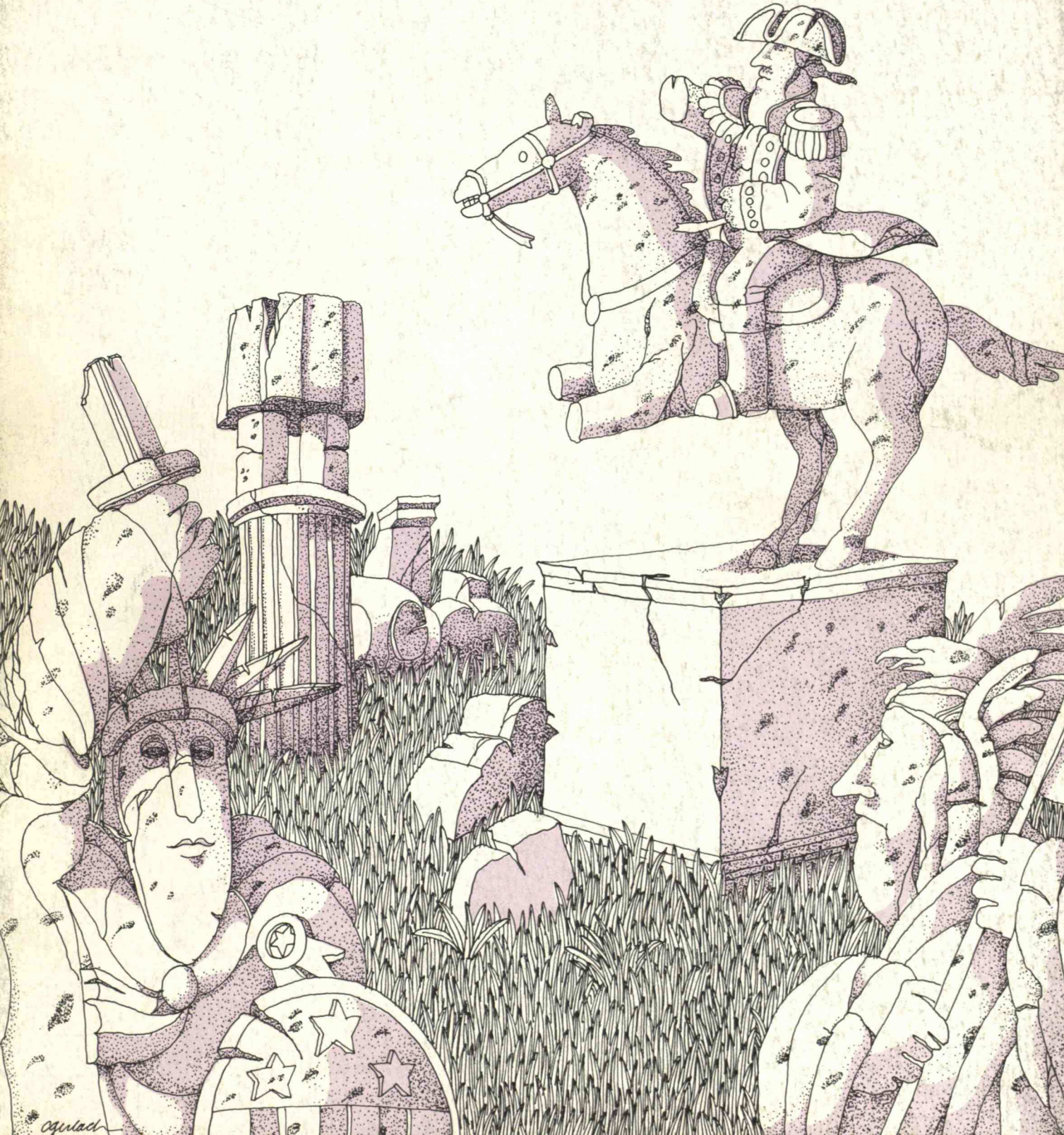
Technology Review

Edited at the Massachusetts Institute of Technology



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Edited at the
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Volume 79, Number 5
March/April, 1977

Technology Review

Articles

Departments

Technology Review, Reg. U.S. Patent Office, is published eight times each year (in October/November, December, January, February, March/April, May, June and July/August) at the Massachusetts Institute of Technology: two special editions are provided for graduate (pp. A1-A32) and undergraduate (pp. A1-A32 and B1-B16) alumni of M.I.T. Entire contents copyright 1977 by the Alumni Association of the Massachusetts Institute of Technology. Technology Review is printed by The Lane Press, Inc., Burlington, Vt. Second class postage paid at Boston, Mass., and at additional mailing offices.

Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge, Mass., 02139. Telephone area code (617) 253-4872.

Price: $2 per copy. Subscriptions: in the U.S., Canada, and Mexico — $15 one year, $24 two years, $32 three years; overseas $23 one year, $38 two years, $50 three years. Please allow three weeks for changes of address and give both old and new addresses in all requests.

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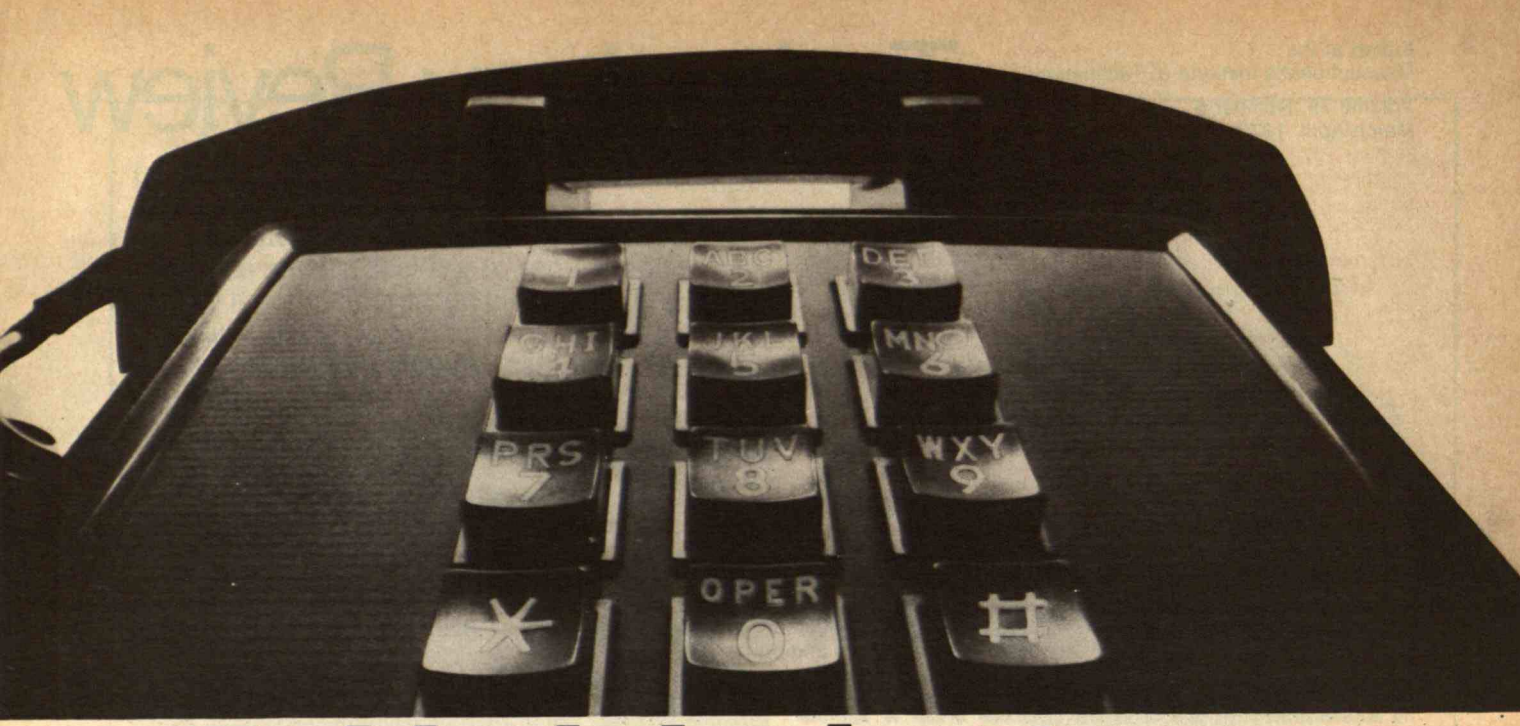

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Letters

Erratum

"Reading Machine for the Blind" (*June, p. 15*) describes the mini-computer-based system developed by Kurzweil Computer Products that can "read" printed texts aloud. The report states that the device is the result of five years' work at M.I.T. and elsewhere. Since Mr. Kurzweil is an M.I.T. graduate, many people have assumed that this work was done as part of my work on text-to-speech conversion (Allen, J., "Synthesis of Speech from Unrestricted Text," *Proceedings of the I.E.E.E.*, Vol. 64, No. 4, April, 1976). In fact, the two projects are separate, and I am not, nor have I been, involved with the Kurzweil Reading Machine project. On the contrary, I have a commitment through the National Science Foundation (with which I am a contractor) to transfer our text-to-speech technology to Telesensory Systems, Inc., which has won an N.S.F. contract to simulate a reading machine.

Jonathan Allen
Cambridge, Mass.

Dr. Allen is Professor of Electrical Engineering and Computer Science, and Associate Director of the Research Laboratory of Electronics at M.I.T. — Ed.

A Vote for the Metric System

The necessity of converting to the "Systeme Internationale" units of measurement has been proclaimed many times in the *Review*. Writing about it and leaving the other guy to do the conversion is not up to the *Review*'s progressive standards. Therefore, in the spirit of progress, I suggest that all technical articles you publish use the S.I. units.

Many people do not realize the difference between a metric system and the "Systeme International" metric. Inconsistencies result from mixing the systems. Let us make sure that in this magazine the metric units are in the form approved by the National Bureau of Standards in 1971, and in that form only.

S. R. Jakuba
West Hartford, Conn.

The Case for Superluminal Transfer

I wish to comment on Martin Gardner's article, "Magic and Paraphysics," (Technology Review, *June, 1976, pp. 42-51*), which contains extensive descriptions of my research, opinions, and speculations.

1. My name was not changed from Sarfatt to Sarfatti. Rather, my original name was officially restored to me. My father's name was Hyman Sarfatti.

2. My Ph.D. in physics is not from San Diego State College, which does not grant that degree. It is from the University of California at Riverside. (I was an assistant professor of physics at San Diego State College.) I have also studied with David Bohm at the University of London and with Abdus Salam at the International Center for Theoretical Physics in Trieste.

3. I am open to the possibility of extra-terrestrial communication from advanced civilizations. However, I do not uncritically or dogmatically believe that such communications with higher intelligence actually are occurring. I maintain a healthy skepticism of the increasing flow of subjective and circumstantial evidence reported by people in responsible positions that allude to extra-terrestrial contact by means other than electromagnetic signals. It is definitely a misrepresentation to identify my position with that of Andrija Puharich and Uri Geller (*p. 46 of Gardner article*).

Contrast my view of the extra-terrestrial question with that of Dr. Frank Drake, director of the National Astronomy and Ionosphere Center at Cornell. In his article, "On Hands and Knees in Search of Elysium" (Technology Review, *June, 1976*) we find statements such as: "All the S.E.T.I. [Search for Extraterrestrial Life] people have been tantalized by the belief that there are alien radio signals passing through our offices and homes which could be detected now with existing equipment if we but knew in which direction and on which frequency to listen" (*p. 25*).

Dr. Drake's position is much more certain about the possibility of extra-terrestrial communication than even I am!

Both S.E.T.I. and my organization, the Physics/Consciousness Research Group (PCRG), fundamentally agree that attempts to communicate with extra-terrestrial intelligence are sane and desirable. S.E.T.I. thinks extra-terrestrials almost certainly exist, that they will communicate by electromagnetic signals and that no earthperson has yet received such signals.

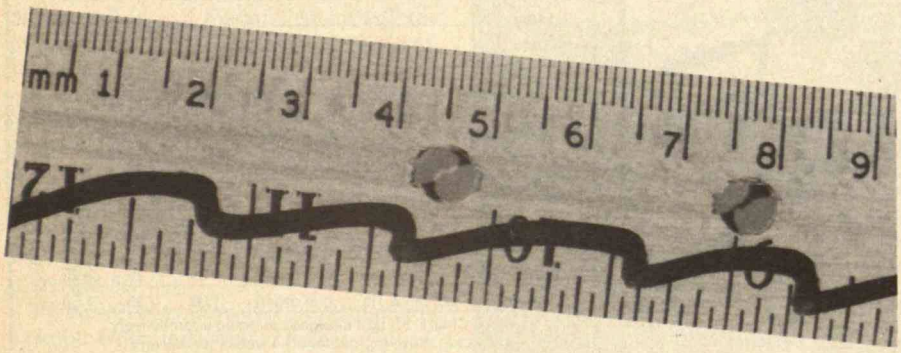
PCRG entertains the possibility that extra-terrestrials exist and that they may choose to use another means apparently allowable within the formal structure of quantum mechanics, namely superluminal quantum communication. An experiment being conducted by Aspect (its design is reported in *Physics Letters*, **54A**, August 25, 1975) is capable of disproving the superluminal quantum communication possibility. If Aspect's experimental results are negative and are confirmed, then PCRG will no longer entertain the superluminal possibility.

4. I deny Mr. Gardner's statement (*p. 51, footnote 7*), "Sarfatti does not doubt that PK powers exist." I do doubt that PK powers — and superluminal information transfer — exist. However, I am open to the possibility of their existence since quantum mechanics apparently has room for them, e.g., John A. Wheeler's "participatory" and Eugene Wigner's "consciousness" interpretations of quantum measurement.

The recent paper by Henry P. Stapp, "Are Superluminal Connections Necessary?" (*Lawrence Berkeley Laboratory 5559, November 8, 1976*) provides strong support for the superluminal information transfer interpretation of the quantum theory. Thus, Professor Stapp writes: "If the statistical predictions of quantum theory are true in general and if the macroscopic world is not radically different from what is observed, then what happens macroscopically in one space-time region must in some cases depend on variables that are controlled by experimenters in far-away, space-like-separated regions. . . . The central mystery of quantum theory is 'how does information get around so quick?'. . . . How does the information about what is happening everywhere else get collected to determine what is likely to happen here?. . . . Quantum phenomena provides *prima facie* evidence that information gets around in ways that do not conform to classical ideas. Thus the idea that information is transferred superluminally is, a priori, not unreasonable."

Superluminal information transfer, if it exists, would surely be used for communications by an advanced extra-terrestrial civilization that did not wish to wait years between information transmissions. Accordingly, why not spend a few million to really check out the quantum superluminal possibility before spending billions of dollars on electromagnetic searches such as Project Cyclops? S.E.T.I., in ignorance of the possible quantum alternative, seems to want to settle the issue of rival forms of extra-terrestrial communication without

Continued on p. 75



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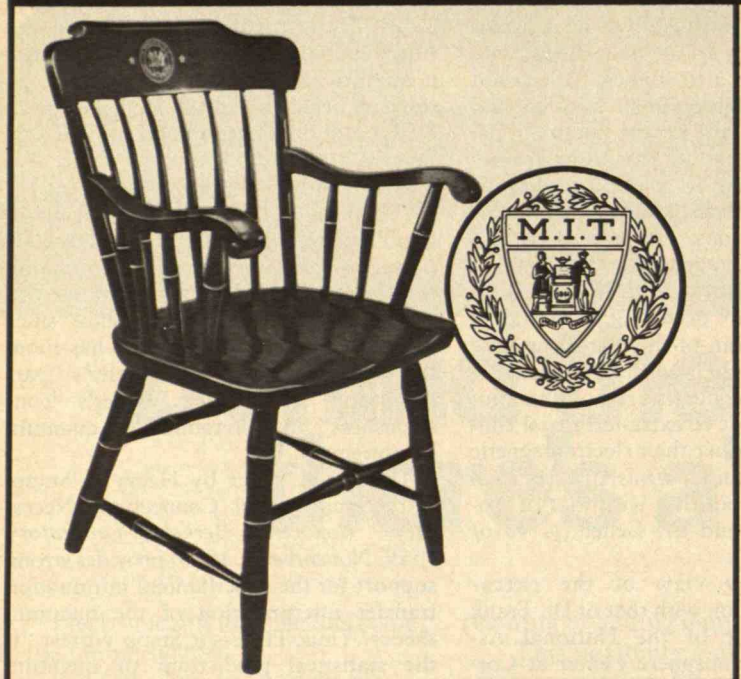
A GOOD WAY TO REMEMBER



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Looking a Gift Horse in the Mouth

"Philanthropies . . . are singularly exempt from criticism."

Technology/Society
by
Kenneth E. Boulding

Technology assessment has become very popular since its embodiment in the federal Office of Technology Assessment. Undeniably, assessment is something that we can and should do as well as possible. It is a little odd, then, that the recent flurry of assessment is confined to technology. If assessment is good for technology, why not assess other activities as well? The Supreme Court constantly assesses the acts of Congress and other elements of the system, though according to the rather narrow principles of constitutionality. Everyone in a hierarchy assesses his or her underlings. Critics assess plays and books. Scientists assess their colleagues' work.

But in this wealth of assessment, we have overlooked philanthropy. The claim that one's motivation is to do good apparently exempts one from any assessment as to whether good has actually been done, or whether something better might not have been done. The Internal Revenue Service, it is true, assesses philanthropic organizations from the somewhat arbitrary point of view of their tax exemption status. If a philanthropic organization avoids activities such as overt lobbying that would void its tax exempt status, the question of the actual fruits of philanthropy seldom arises.

Edsel's Law

We apply very different standards of moral judgment to matters of exchange than we apply to grants. Those institutions that survive by finding a niche in the exchange system, particularly businesses, are regarded with moral neutrality, if not disfavor. It is as if the intellectual and the pious consider such activities as making, buying, and selling things, handling money, making profits, and providing employment, to be distasteful and crude. If a business transgresses, Ralph Nader or the Department of Justice antitrust division, or the Food and Drug Administration, or any one of dozens of other vigilantes, will pounce. No doubt this is as it should be.

Philanthropies, however, are singularly exempt from criticism. These organizations acquire virtue by mere giving, and inquiring into the effects of the disbursements seems almost improper. The law itself, particularly the income tax law, blesses these disbursements, particularly those of the rich. Up to 75 per cent of the bounties of the rich are actually paid for by the taxpayer or by the victims of inflation. And there is no public demand whatever that they be efficient.

The trouble is, of course, that efficiency in philanthropy is not a measurable virtue. Unlike the marketplace, philanthropy tends to have rather poor feedback. I have sometimes called this "Edsel's law": if Ford Motor Co. produces an Edsel for the market, it soon discovers it has made a mistake; if the Ford Foundation produces an "Edsel," it may never know. (I should add that I have no animus against the Ford Foundation, whose bounty I have enjoyed, through extraordinarily wise and efficient grants which have given me cause for honest gratitude rather than for complaint.) But the general problem is real, and many philanthropists and foundation executives desire feedback from the recipient and — even more difficult — from potential alternative recipients.

Ethic and Organization

If we had an Office of Philanthropic Assessment, what would it do? The obvious tasks are collecting reports, publishing the costs of various philanthropies, and exposing gross malfeasance. The Office may be stymied in its effort to assess efficiency. But even if the Office merely asks questions for which there are no easy answers, its service will be valuable, if only because people will think twice. Environmental impact statements may do no more, and are still worth the effort.

I wish we could persuade the philanthropic community, and especially the decisionmakers of foundations and of all the committees for this and that deserving cause that good intentions are not on a par with real effectiveness, and that good will is not a substitute for skill. Good will is probably necessary, but certainly not a sufficient criterion for philanthropy.

If philanthropies might be studied with a little humility, we might see a clearinghouse for philanthropic enterprise to encourage cooperation and foster constant debate of greatest need and most effective action. Assessment — of anything — is not a single act to be done once and for all. It is a spirit and a continual process and it must be facilitated both by an appropriate ethic and by appropriate organization.

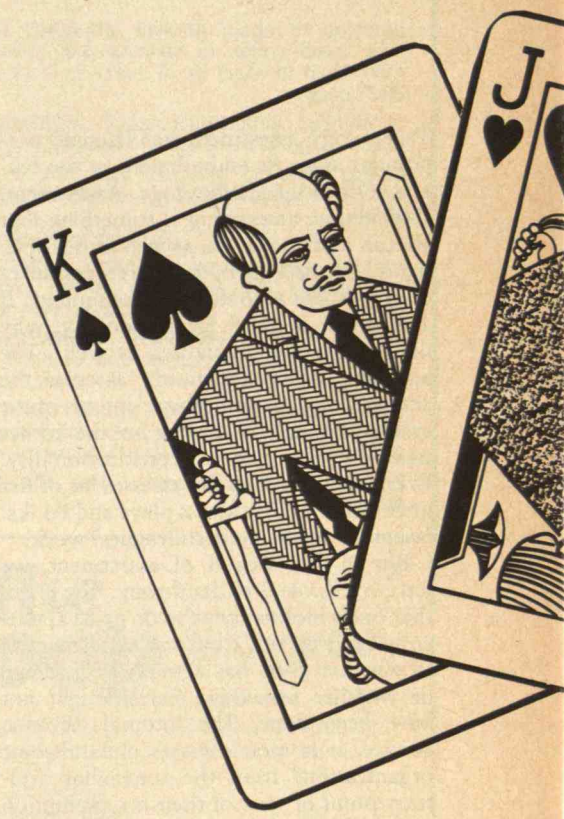
Kenneth Boulding is a director of the Institute of Behavioral Science at the University of Colorado. He writes regularly for Technology Review.

Photo: Thomas Jenkins

Congress Reshuffles Its Science Committees

"The Senate has essentially placed control in the hands of people with little experience in managing the federal government's vast scientific enterprise."

Washington Report
by
Colin Norman



Early in February, after weeks of behind-the-scenes negotiations, hard bargaining, and a lengthy public debate, the Senate completed a long-overdue reorganization of its antiquated and hopelessly inefficient committee system. The House of Representatives, which went through a similar reconstruction a couple of years ago, has also tinkered with its committee responsibilities for nuclear energy legislation. The outcome of all this reforming zeal, although not exactly a model of clarity and efficiency, is an improvement, and could have some important implications for science and technology on Capitol Hill.

Improvement has long been needed. Senate committees have scarcely been revamped in 30 years, and a great deal of overlap and confusion has resulted as issues and priorities wax and wane in congressional attention. The confusion and delay that has sometimes resulted is illustrated by what happened recently to a solar energy bill.

In 1974, the House of Representatives passed a politically popular bill to provide government support for the production, installation, and testing of solar heaters — the idea being to stimulate the growth of the nascent solar energy industry. Election year politics were expected to sweep the measure smoothly through the Senate to the tune of self-congratulatory rhetoric extolling Congress' good sense in paving the way for solar power. Not so.

Because the bill gave the National Aeronautics and Space Administration (N.A.S.A.) a role in the demonstration program, the Senate Committee on Aeronautical and Space Sciences, which has authority over N.A.S.A., claimed jurisdiction over the measure. But the bill provided for a demonstration program involving the National Science Foundation, the National Bureau of Standards, and the Department of Housing and Urban Development, authority for which falls under the Committee on Labor and Public Welfare, the Committee on Commerce, and the Committee on Banking, Housing and Urban Affairs, respectively. Naturally, these three committees also claimed jurisdiction. The bill thus was referred to four separate Senate committees. Though none of them made any major changes, congressional action on the measure was effectively delayed for several months.

Similar competition also occurred last year over the legislation to re-establish a science policy office in the White House. That bill was finally referred simultaneously to three separate committees.

Chaos into Less Chaos

The committee realignments approved by the Senate in February certainly do not insure against such jurisdictional disputes, but they will help to reduce the chaos. In the areas of science and technology, the principal changes are the abolition of the Committee on Aeronautical and Space Sciences and the Joint Committee on Atomic Energy, the consolidation of science policy responsibility in the Commerce Committee, and the expansion of the Interior Committee, which has gained authority over most energy matters. Several senators who had been prominent in scientific affairs either failed to be re-elected or retired last year, and this circumstance facilitated the changes.

A special select committee which had been meeting under the chairmanship of Senator Adlai Stevenson (D-Ill.) proposed the committee system reforms late last year. The original proposals would have done away with 16 of the Senate's 31 committees, panels, and joint committees, and would have severely limited the number of committees and subcommittees on which each Senator can sit.

The proposals met with stiff resistance from those committee chairpeople whose panels (and authority) were jeopardized, and consequently a number of proposals were revised before they even reached the Senate floor. The Committee on Veterans Affairs, for example, was retained, and a special committee on aging was also spared. A number of voters have a special interest in seeing the two preserved, which was one reason for their reprieve.

No such constituency existed for the Committee on Aeronautical and Space Sciences, however, and its abolition was further eased by the fact that the chairman, Senator Frank Moss (D-Utah) was unseated last year. Few laments greeted that committee's authority merger with that of the Commerce Committee.

One particularly noteworthy change from the select committee's original recommendations, however, concerns jurisdiction over the National Science Foundation (N.S.F.). Since N.S.F.'s mission is to support scientific research, the select committee naturally suggested that jurisdiction over N.S.F. should be placed along with most other science and technology affairs, in the Commerce Committee. But Senator Edward Kennedy (D-Mass.), whose subcommittee of the Labor and Public Welfare Committee had jurisdiction over N.S.F., objected. He is not a member of the Commerce Committee, and wanted to retain jurisdiction over N.S.F. So, the Labor and Public Welfare Committee has been renamed the Committee on Human Resources, and retains its authority over N.S.F. The somewhat spurious reasoning is that since N.S.F. supports some education programs,

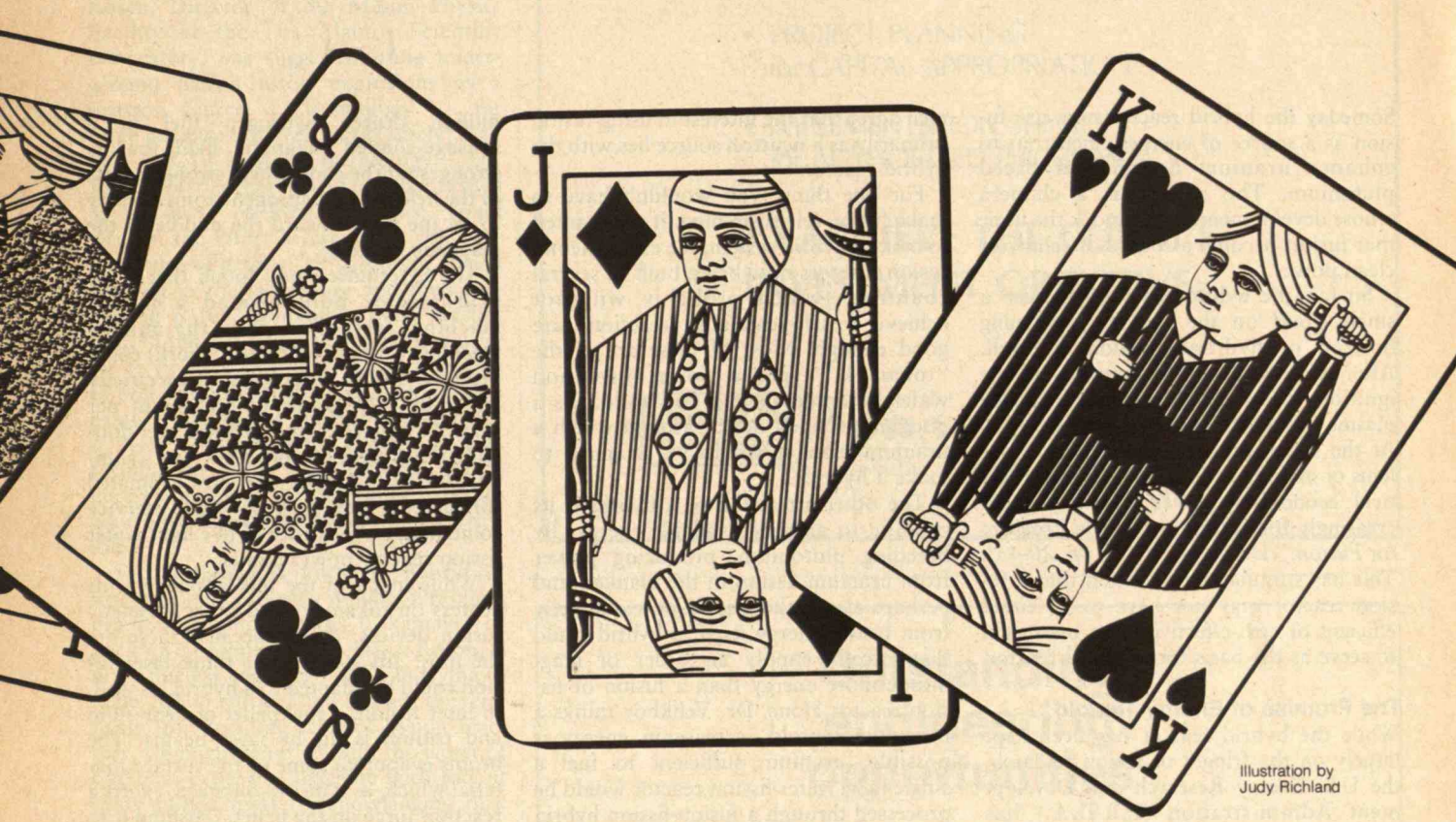


Illustration by Judy Richland

N.S.F. can be considered a human resources agency. This is not exactly logical, but is typical of the way Congress works.

The realignment has left untouched the real powerhouses, such as the Appropriations Committee and the Armed Services Committee. But by consolidating most science and technology authority in the Commerce Committee, the Senate has essentially placed control in the hands of people with little experience in managing the federal government's vast scientific enterprise. It will be interesting to see how well they adapt.

An Overdue Demise

Perhaps the most important change is likely to be the abolition of the Joint Committee on Atomic Energy, since its demise will radically affect congressional handling of nuclear matters. The Joint Committee reigned supreme over nuclear policy in the United States for over a quarter of a century, and in the process developed a strong pro-nuclear bias. It was a unique committee in a position of immense power, since no other committee in Congress has legislative authority in both the House and the Senate. Its power was wielded skillfully to push nuclear legislation through the Congress and, according to a devastating study by the citizens' lobbying unit, Common Cause, it frequently ignored the views of nuclear critics. That committee's demise was probably long overdue.

The Joint Committee's responsibilities in the House have been parcelled out to four separate committees. The Committee on Science and Technology takes over jurisdiction over nuclear research and development, the Armed Services Committee oversees responsibility for nuclear weapons, and authority for nuclear regulation devolves to the Interior and Commerce Committees, with the Interior Committee getting most of the authority. In the Senate, the Interior Committee (now called the Committee on Energy and Natural Resources) was awarded the lion's share of the Joint Committee's authority, while the Armed Services Committee gained authority over nuclear weapons. The Public Works Commitee was given jurisdiction over nuclear regulation.

This change may be significant. Nuclear promotion and regulation now rests in separate committees. Nuclear matters will now receive a much more thorough going-over in Congress. In that regard, it should be noted that the key subcommittee in the House concerned with nuclear regulation is headed by Rep. Morris Udall (D-Ariz.), who has frequently expressed misgivings about the nuclear program in general and about the breeder reactor in particular.

Although all of these changes have scarcely received any attention in the general press, in the long run they could well prove to be just as important as the new appointments to scientific agencies by the Carter administration.

Colin Norman is Washington Correspondent for Nature *and writes regularly for* Technology Review.

Dirty Directions for Nuclear Fusion

"You don't have to be a skeptic to consider hybrid fusion a technology for the faint-hearted."

Science Report by Robert Cowen

Someday the hybrid reactor may use fusion as a source of energetic neutrons to enhance uranium fission and breed plutonium. The reactor is a chimera whose development would mock the hope that fusion become a source of relatively clean power.

So far, the hybrid reactor has been a small cloud on the slowly brightening horizon of hydrogen fusion research. After two decades of inching toward the ignition of a self-sustaining reaction, plasma physicists have that goal in sight. At the same time, the engineering problems of making fusion the basis of a practical, economical power plant appear increasingly formidable (*see "The Prospect for Fusion," December, 1976, pp. 20-43*). This has stimulated the notion that a fusion reactor may not have to be either efficient or cost-effective in its own right to serve as the basis for a hybrid reactor.

The Promise of Energy Tenfold

While the hybrid reactor has been kept largely on the fringes of fusion research, the U.S. Energy Research and Development Administration (E.R.D.A.) has sponsored its study. The concept gained some prominence when it was discussed at the Second Topical Meeting on the Technology of Controlled Fusion at Richland, Wash., last September and at the Joint U.S.-U.S.S.R. Symposium on Fusion-Fission Hybrid Reactors held at Lawrence Livermore Laboratory in July. It surfaced again during an interview in Washington with Edwin E. Kintner, who heads E.R.D.A.'s Division of Magnetic Fusion Energy, and Evgeni P. Velikhov, Deputy Director of the Kurchatov Institute (Moscow) and Supervisor of Fusion Studies.

Dr. Kintner says that fusion is a rich source of neutrons that are valuable in their own right. Even if a fusion reactor did not itself run a power plant, its neutrons could release hydrogen from water, allowing energy to be recovered in that form. Dr. Velikhov adds that the neutrons could "burn up" transuranium elements (the longer-lived part of nuclear waste), transmuting them to elements with shorter radioactive half-lives. However, both men agree that the interest in using fusion primarily as a neutron source lies with the hybrid reactor.

For one thing, you wouldn't have to make fusion self-sustaining. If you wanted to make a hybrid system, the experimental fusion reactors now being built in several countries (which probably will not achieve a self-sustaining reaction) are good enough. Most of these are of the "tokamak" type, a Soviet invention widely adopted around the world. It's a doughnut-shaped device around which a uranium blanket would be wrapped to make a hybrid.

The other attraction of a hybrid is its promise to amplify available energy. By breeding plutonium, producing power from uranium fission in the blanket, and perhaps also making some power directly from fusion energy itself, a hybrid could theoretically supply an order of magnitude more energy than a fusion or fission reactor alone. Dr. Velikhov thinks a minimum tenfold increase in energy is possible; uranium sufficient to fuel a single light water fission reactor would be processed through a fusion-fission hybrid to keep ten light water reactors going. The hybrid reactor itself would cost far more than a single fusion or fission device. But Dr. Velikhov says that if you divide the cost among the entire system of ten power plants and one hybrid breeder, the breeder would not be excessively expensive. So the U.S.S.R. is tilting its fusion program in that direction.

Dr. Kintner said he doesn't think that will happen in the U.S., despite considerable talk about hybrids, because the concept of a plutonium energy economy is already deviled by opposition. Dr. Velikhov expects no such problem in the U.S.S.R., where there are no noisy environmentalists to deter development.

Power at 5.5¢ a Kilowatt

Such American studies tend to confirm Dr. Velikhov's expectation that fusion will be a superior plutonium breeder. For example, Ralph Moir and others at Lawrence Livermore Laboratory have looked at a hybrid based on the magnetic mirror machine. The device confines the .100-million degree hydrogen fuel in a sausage-shaped magnetic field that is strongest at the ends. These stronger parts of the field reflect hydrogen atoms that try to escape back toward the middle of the magnetic "bottle."

The Livermore study found that a hybrid reactor built around a mirror machine (assuming that the mirror machine itself can be made to work) could produce 1,000 megawatts of electricity and 3,000 kilograms of plutonium per year. As a breeder, the hybrid's fuel doubling time might be only a few years compared to the 12 to 50 years now estimated for breeder reactors. It could service something on the order of five light water fission reactor power plants.

While much of the talk about hybrids centers on tokamaks and other magnetic fusion devices, chiefly because these are the most advanced, some think laser fusion could be adapted to a hybrid, as well. In laser fusion, a fuel pellet of deuterium and tritium is hit by laser beams. The beams evaporate some of the surface material which, as it moves outward, exerts a reaction force on the pellet, crushing it to high density and raising its temperature.

Jim Maniscalco at Lawrence Livermore, in consultation with Bechtel Corp., has looked at a laser fusion hybrid he thinks could produce enough plutonium for half a dozen light water fission power plants. About 90 per cent of the power from this hybrid would come from fission in a blanket of uranium-238 tailings surrounding the fusion reactor core. Since design details of hybrid power plants are speculative, cost estimates can't be taken too seriously. For what it's worth, though, Dr. Maniscalco has figured a $2 billion hybrid could make power at something like three times the cost of atomic electricity today, or 55 mils a kilowatt hour. With power costs rising, he thinks such a figure won't sound quite so ridiculous in another ten years.

Meanwhile, one should remember that the concept of laser fusion itself is still a bit speculative. Among other uncertainties, no one yet has come up with lasers powerful enough, efficient enough, and rugged enough to do the job. Indeed, Dr.

Maniscalco himself thinks a laser hybrid reactor is attractive since it could use less efficient lasers and fuel pellets than would be needed for a reactor that had to justify itself on its own.

Insurmountable Difficulties

You don't have to be a skeptic to consider hybrid fusion a technology for the faint-hearted. If fusion researchers felt more certain that pure fusion were going to work, there would be less talk about hybrids and making do with inefficiencies. With more than a hint of sarcasm, Louis Rosen, Director of the Meson Physics Facility at the Los Alamos Scientific Laboratory, has suggested using underground fission-fusion explosions as a neutron source: a "technology ... far more advanced (it even works safely) than our C.R.T. [fusion] technology." Dr. Rosen worries that hybrid fusion, pursued as a course of least resistance, could weaken the effort to crack the still very tough nut of getting self-sustaining fusion running in the laboratory and then harnessing it for economic power. He has said, "I think it might be a great loss were we to proceed into large-scale endeavors to breed fissionable material, with devices as uncertain and as difficult as tokamaks, if those occurred at the expense of performing the really basic research that is necessary at least to determine whether controlled fusion reactors are indeed feasible."

Such a disaster is not likely; hybrid fusion may fall of its own weight. Wrapping uranium around a torus (tokamaks) or packing it around a sphere (laser fusion) is not a nuclear engineer's ideal. In trying to make fusion efficient and upstage the relatively low breeding rates of fission reactors, we might wind up with the worst of both: an expensive machine with lots of nasty radioactivity. Acknowledging this, M.I.T.'s Lawrence Lidsky says the engineering problems of the hybrid "are likely to be insurmountable."

All the same, the hybrid reactor remains — at this stage — a concept to be reckoned with in assessing energy options. A lot of support for fusion research in the U.S. comes from those who see it as a reasonably clean alternative to radioactive-waste-producing fission power. As with all simplistic assessments, this view has tended to discount the many, and great, technical uncertainties involved. Since these uncertainties are tending to nudge fusion in what environmentalists will consider the wrong direction, we may want to take a fresh look at the energy scene.

Robert Cowen is Science Editor of the Christian Science Monitor *and writes regularly for the* Review.

Confessions of an Environmental Miser

"There are only two ecologically acceptable ways to maintain a lawn: fence it and keep a sheep, or install Astroturf."

Technology/Environment
by
Ian C. T. Nisbet

How does an individual consumer who is concerned about his or her impact on the environment translate that concern into action? Any attempt to answer that question leads first to housing and transportation, which are the largest single purchases that most of us make. Houses and automobiles are most people's largest single investments in materials, their largest single uses of energy, their largest impacts on space, and their greatest producers of air and water pollution.

Responsible Use of Automobiles

Environmentally conscious consumers seek small, efficient, durable automobiles and use them as sparingly as possible. My own family owns only one small car, a 1969 model. It is driven about 1,000 miles per month, of which 250 miles represent my wife's commuting. That is more than I would consider reasonable, but since the car averages about 27 miles per gallon, we use only some 37 gallons of gasoline per month — no small amount, but a level of consumption considerably less than the U.S. average of 42 gallons *per capita*.

Of course, there are times when I could use a second car, or a vehicle with more capacity; but there are only half a dozen occasions each year when I am genuinely inconvenienced, and then it makes more sense to rent a vehicle. If my job did not keep me working and living in darkest suburbia, I might not own a car at all.

The issue of when to replace one's car is complicated by the fact that new cars pollute less than old ones, so that one has to balance the resource and economic costs of a new car against the economic *and* the external costs generated by running an old one. Until 1976 the inefficiency of new cars substantially offset the environmental advantages of their improved pollution control, but the 1976-model American cars were for the first time clearly preferable to their predecessors because they were both less polluting and more economical. However, further improvements are coming. To buy a new car now is to burden the environment for seven to ten years with a more wasteful, more polluting machine than will be available in the interim. So, while recognizing that my old car pollutes more than a 1977 model, I have resolved not to buy a new one until the "1977" statutory emission limits are met — even if I have to wait until 1980. Balancing all resource and environmental considerations, I think this is a socially sound decision and I recommend it.

Energy Conservation in the Home

A house represents a major investment in matrials, but its most important single environmental impact over its lifetime is the energy required for heating and cooling it. For economic reasons alone, a well-informed purchaser of a new house today will insist that it be well insulated and will either install solar heating or at least make provision for subsequent installation. However, it is not yet clear whether money is better invested in "passive" or "active" solar heating. A passive system consists basically of a well designed house, planned so that solar radiation is admitted in the winter and excluded in

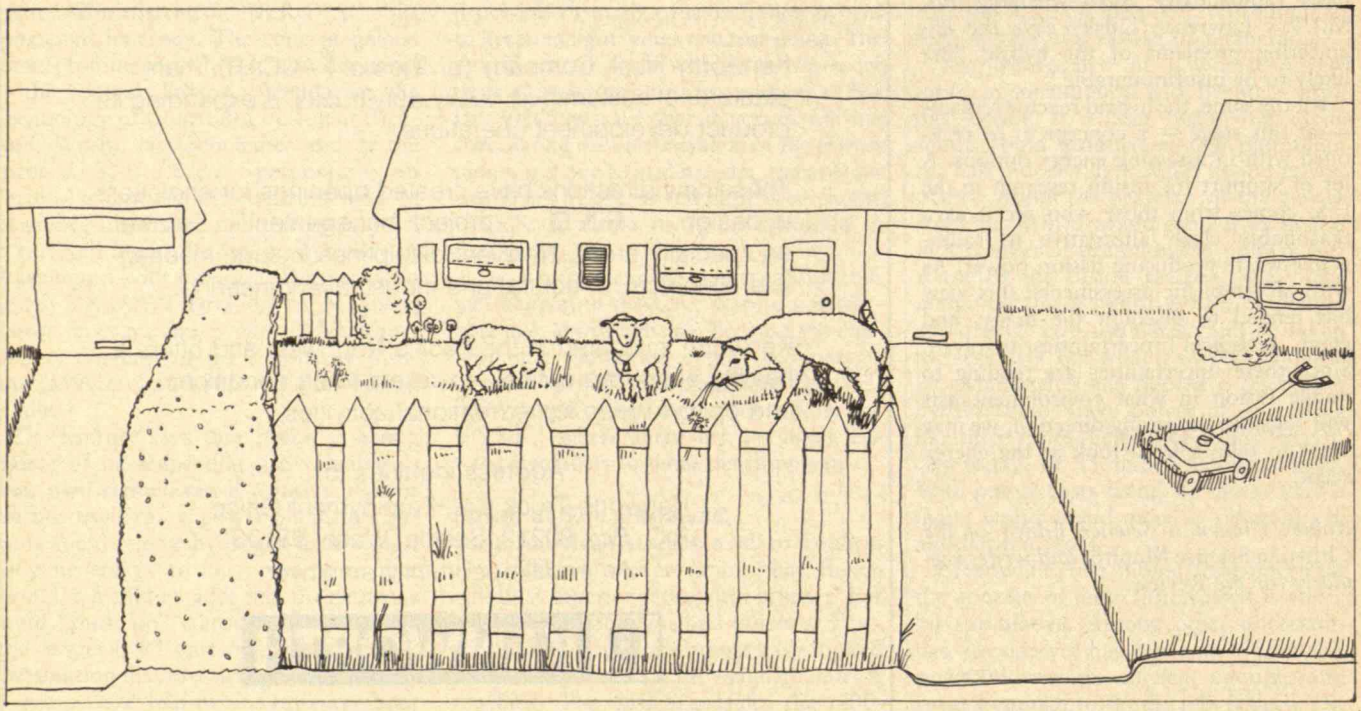


Illustration by Judy Pokras

summer. With full insulation, the energy requirements of such a house may be 80 per cent less than those of a conventional home of similar size built a decade ago. It is then questionable whether active solar heating (collectors with a storage and distribution system) and solar cooling would justify their high capital costs.

Older houses raise different questions. The insulation of my own house is only fair to poor, and despite frugal use (I keep my thermostat at 62° F, which is too cold for many visitors) we burn about 700 gallons of heating oil in the average year — nearer to 1,000 gallons this winter. Bearing in mind that at least one third of my electricity bill represents waste heat which helps to warm the house in winter, I could probably save at least $250 per year by installing really good insulation. But a thorough job would cost some $2,000. Viewed strictly as an investment, this expenditure is only marginal with present-day fuel costs.

A key factor in this decision is that I rent my house and I do not want to invest substantially in my landlord's property without assurance of a rapid return. And having been a landlord, I know that there is little incentive to invest in property improvements whose value is not generally appreciated by tenants and potential future buyers. If we are to effect energy conservation in older buildings, we must devise incentives that will overcome this conflict between the interests of tenants and landlords.

Sprinklers, Sheep, Stoves, Scrubbers

The design and use of housing may have many substantial environmental impacts. Here are four other items whose implications are usually overlooked:

—*Paint* conveys substantial economic benefits, but its manufacture and use — production, formulation, and application — cause significant environmental impacts. The recent trend to latex paints has substantially reduced air pollution by hydrocarbon solvents in oil-based paints, but other problems remain. Vinyl and aluminum siding may offer substantial net advantages if the claims made for their durability are justified. Unpainted shingles are better still.

— *Indoor air pollution* is a serious problem too widely overlooked or dismissed. Human exposure to almost every significant toxic pollutant is generally greater indoors than outdoors. Examples include: mercury from paint fungicides; many pesticides used indoors which linger in vapor form or in house dust; solvents used in paints, thinners, cements, etc.; dry-cleaning fluids; plasticizers; flameproofers; carbon monoxide, benzopyrene, nitrosamines, and cadmium from cigarette smoke; carbon monoxide and polycyclic hydrocarbons from smoking fires; nitrogen oxides from gas flames, etc. Ironically, measures to promote energy conservation by preventing losses of warm air increase the retention of pollutants in indoor air, and hence increase human exposure.

— *Lawns* are ecological monstrosities. In nature, grassland is found only in zones of relatively low rainfall and is maintained by fires and grazing. Attempts to maintain grassland in climates where the natural vegetation is forest or desert require continual, expensive maintenance. One ecological study of a California lawn showed that the energy expended on lawn maintenance exceeded the net production of the plants by a factor of four to five. There are only two ecologically acceptable ways to maintain a lawn: fence it and keep a sheep, or install Astroturf.

— *Wood fires* are pleasant to sit by, but they are extremely inefficient sources of heat and they produce large quantities of particulates, carbon monoxide, and other air pollutants. Stoves are more efficient and less polluting but nevertheless typically produce more particulates, carbon monoxide, and sulfur oxides per unit of heat than we permit from new fossil-fueled power plants. Wood fires may not do much harm if they are limited to dispersed suburbs and rural areas, but burning wood as primary fuel in urban areas conjures visions of a scrubber on every stove.

Ian C. T. Nisbet is Associate Director of the Scientific Staff, Massachusetts Audubon Society; his Ph.D. (in physics) is from Cambridge University. Dr. Nisbet is a regular contributor to Technology Review.

Painful Lesson in Self-Reliance for U.S. Automakers

"The old yardstick of return on investment doesn't always apply with regard to energy."

Special Report by Janet Kreiling

The shortage of natural gas hit hardest this winter in the Midwest, crippling the nation's automakers. The response of the industry was to look for new ways to save — and in one case to go into the energy business for itself.

Although General Motors suffered along with the rest of the industry, its situation was relieved by the 100 million cubic feet of natural gas it pumps each day from its own 35,000-acre field. The gas powers the company's huge Central Foundry at Defiance.

Given the choice, G.M. would stick to autos, but its Ohio plants have had their supplies of natural gas curtailed. So in 1972, when a private developer offered G.M. the field of shallow lens-shaped pockets unwanted by Ohio's utilities, the company grabbed it, hired geologists and well-tenders, and began to dig. It has dug 100 natural gas wells, connected them all with collector pipes, built a compressor station, and learned to run the whole thing — activities it still prefers to leave to the utilities.

G.M. has sunk several million dollars into the field, and several million more into a 40-mile pipeline to bring gas from Maumee to Defiance, Ohio, where G.M.'s Central Foundry takes the company's gas curtailment in a single lump. The foundry turns nodular and grey iron into engine blocks, engine heads, differential cases, crankshafts, and other parts for its parent and the other three automakers. It uses an Eastern Ohio Gas pipeline from the well field to Maumee, for a fee set by Ohio's Public Service Commission at 25 per cent of its gas.

"We're now producing the gas at about its intrastate price," says Gabe Tiberio, Director of G.M.'s Energy Management Section. "But we'll pay, if we have to, twice the intrastate price. We must have the gas. The old yardstick of return on investment doesn't always apply with regard to energy."

"We bought the fields to backstop our plants if curtailments were imposed," says William Illuminati, also of the Energy Management Section. "With the severe weather and the severe shortage, the gas we produce hasn't been sufficient to keep the plants going. Several had to be shut down. In fact, we're powering a plant in Dayton with propane gas, and even that's not sufficient to meet demand." The only solution Mr. Illuminati sees is for G.M. to continue developing the gas fields: he hopes "next year we'll have enough fuel to keep our plants open."

Only a Few Elephants

G.M.'s operations in the U.S. used some 700 billion cubic feet (B.c.f.) of natural gas in 1975 to make over 5 million cars and trucks. That number is down by some 5 B.c.f. from 1974, when 75 B.c.f. were used to make about the same number of vehicles. In fact, in 1975 G.M. spent over four per cent less energy of all kinds per car, using a total of 195 trillion B.t.u.s nationwide.

So the company is looking beyond its gas field to an even more secure energy "source": conservation. In the past few years, G.M. has found a number of ways to save natural gas:

— A stack heat recuperator on a paint-drying oven preheats incoming air to save 2.5 billion B.t.u.s annually.

— Some porcelain-coated parts require drying before they are fired. By applying a porcelain powder electrostatically, the company bypasses the drying oven and saves 24 million cubic feet (M.c.f.) a year.

— Sintering furnaces require a protective gas atmosphere. By connecting 18 of them to a shared system of 19 gas generators, rather than to individual ones, G.M. saves 23.4 billion B.t.u.s a year.

Small savings, Mr. Tiberio remarks, but they add up. And they are worth going after. "Once in a while," he adds, "we do come up with an elephant." He describes a waste heat recovery system on a cupola at the Central Foundry that saves 400 billion B.t.u.s of gas a year. "But savings of that magnitude usually involve comparable expenditures — this one in excess of a million dollars," he says.

The other auto manufacturers are conserving just as strenuously, and just as minutely. Says Jim Harbour, Director of Manufacturing Engineering Planning and Services at Chrysler: "We pick up savings in little pieces, a half per cent there, sometimes a whole per cent, if we're lucky."

Mr. Harbour says one of Chrysler's elephants is the recuperator on a heat-treating furnace that preheats incoming air. The recuperatory has not only saved some 30 per cent of the fuel used, but also speeds pieces through the furnace 30 per cent faster. The company is also looking at recuperators for paint-drying ovens, to save one per cent or more of Chrysler's total energy bill.

G.M. looks at paint-drying ovens from another angle: it is trying to develop a faster drying paint and has already saved 22.8 M.c.f. a year by substituting a sealer on body parts for a prime paint that requires wet sanding and oven drying.

Automakers are also trying to save energy by changing design specifications. For example, a rear-axle side gear might be cold-formed rather than hot-forged, and a bearing part could be made of high carbon steel rather than metal that needs hardening. But such changes are not often simple. "Each one," says Harold Walters of Ford's Energy Planning Department, "requires exhaustive metallurgical study to make sure the part will continue to perform as it should." Then the part must be costed out and its manufacture fitted into the production line.

A Costly Conversion

Despite conservation measures, John Ricca, another G.M. energy specialist, believes that U.S. industry, including G. M., "faces the grim prospect of losing most or all its gas supply for such process uses by 1980, depending on the location and supply posture of the pipeline." Most of these process uses can be curtailed in times of shortage by the Federal Power Commission; but the economic impact of their curtailment on the nation, Mr. Ricca says, "threatens to be overwhelming." He cites a study done for General Motors by Arthur D. Little, Inc., that finds the cost of converting a large boiler with an 80-percent load factor from gas to oil or coal to be only 1.4 cents per M.c.f. displaced. But converting a small boiler with a load factor of only 25 per cent can cost up to 23.5 cents per M.c.f. Complex changes will cost still more. And if the whole boiler

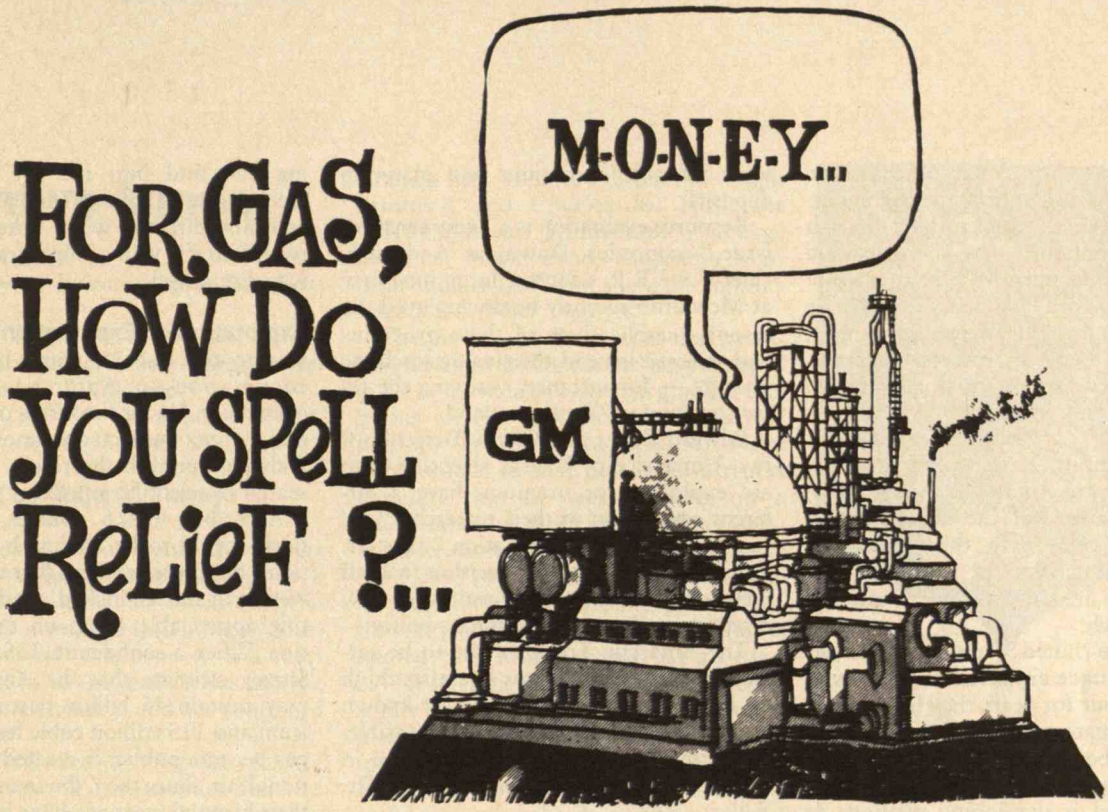


Illustration: Mike Peters; United Feature Syndicate

system must be scrapped, its replacement could cost as much as $10 per M.c.f.

Changing other equipment that uses gas is even costlier, Mr. Ricca says — as high as $33 per M.c.f. displaced. If the U.S. commits 5 trillion cubic feet of gas to the "superior" uses, it faces a bill of $150 billion over the next few years for conversion to oil or coal. At present, we spend $120 billion per year on new plants and equipment: spending, Mr. Ricca points out, "that increases efficiency and productivity." Two billion dollars of that total is G.M.'s alone.

To ease the conversions, G.M. pleads for a thoughtful plan for natural gas. "There is no other fuel or commodity so vital to industry that is so over-regulated, so mismanaged, and so misused as natural gas," Mr. Ricca says. Even now, Congress is considering amending the Natural Gas Act of 1938 in a way that permits some utilities to burn gas under their boilers for another 10 to 12 years.

The incentive to use gas is clear: 1 million B.t.u.s require 79.1 cents worth of gas, 82.1 cents worth of coal, and 200.8 cents worth of heavy oil. Yet the marketed production of gas in 1975 was down 7.4 per cent from 1974, and that down 11 per cent from 1973. New reserves are destined for the intrastate market, where new gas attracts nearly four times the interstate price of 52 cents per M.c.f.

Automakers are also anxious for the formulation of a national energy policy which deals with all fuels and includes the necessary modifications to environmental laws to accelerate greater use of coal and nuclear power. With a national energy policy, G.M. could decide finally what to do with the cupola at Central Foundry. The company began using gas for the supercharge because gas was cheap. It uses gas now because it has its own secure supply. G.M. wants to convert to oil, but not without some idea of what political and environmental policies will do to oil's availability and cost.

While Mr. Ricca and his colleagues demand energy planning, they complain that legislators and bureaucrats don't understand enough about industrial processes to write reasonable requirements. The auto industry is already conducting one running argument over numerical limits on engine emissions; it doesn't want to add another to its agenda.

The problem is complicated by the fact that agreement on numerical limits is as difficult to achieve within the industry as without. "In our own conservation program at G.M.," says Gabe Tiberio, "we've had a hard time determining yardsticks. Did one plant achieve a 12 per cent reduction and another only five per cent? Perhaps the first was very lax to start with. Which case do you look to as a standard?"

Although automakers look to federal energy planning for stability, they do not look forward to government interference. Says Mr. Harbour at Chrysler, "Our energy costs went up 98 per cent between 1972 and 1975, and that's enough to encourage any corporation to save."

Janet Kreiling has been Associate Editor of Technology Review *and later, a member of the corporate public relations staff of Chrysler Corp. She is now a correspondent, based in Pittsburgh, for* Energy User News, *a new multidisciplinary magazine.*

Antarctica: Geopolitical Football

"To a number of nations, Antarctic 'research' is tantamount to resource exploitation."

National Report
by
David F. Salisbury

Scientific research in Antarctica has been peculiarly ambivalent from the beginning.

Robert Scott, the noted British explorer, maintained that his expedition was for scientific purposes, not an attempt to reach the South Pole first. Yet when he learned that the Norwegian adventurer, Roald Amundsen, was also on the continent, he raced him to the polar plateau. He lost not only the race but also his life as a result.

Seven nations have conflicting territorial claims to Antarctica. But in 1961, at the instigation of the United States, they joined with five other countries to put their claims in abeyance, demilitarize the area, and open it to international research.

Neither the United States nor the Soviet Union have made any territorial claims in Antarctica, but for years they have maintained the greatest "presence" there.

To a number of nations Antarctic "research" is tantamount to resource exploration. Poland is developing methods to harvest krill, a small crustacean which flourishes in antarctic waters. They think that krill will become an important source of inexpensive protein. The Soviets recently announced the discovery of a mountain of high-grade iron ore and have established a new base in an area where coal has been found. East German scientific papers continually stress the fact that they are searching for valuable resources.

Many of the participants in the U.S. Antarctic Research Program (U.S.A.R.P.), however, share the ambivalence of Robert Scott. They refuse to consider, at least publicly, the geopolitics behind the American presence on the polar continent.

Research on Ice

This season the National Science Foundation is supporting several resource evaluation programs. One is an attempt to inventory the amount of uranium in the dark sandstones which band the cliffs in the dry valley region of Victoria Land. The rock is similar to sandstones in the western United States where uranium has been found. Another project is an expedition to the Dufec Intrusive, an extension of South African geologic strata that contains valuable chromium and platinum deposits.

Resource evaluation is a "very sensitive issue," concedes Duwayne Anderson, chief U.S.A.R.P. scientist. In an interview at McMurdo recently he downplayed the resource implications of these programs and stressed instead their value for basic geology — for instance, verifying the reconstruction of Gondwanaland.

Edward Zeller and Gisella Dreschhoff, two University of Kansas scientists who are exploring for uranium, have a different conception of their research. "Our real goal is resource evaluation," says Dr. Zeller. He feels that the decision to fund their particular research constitutes a new direction in American Antarctic policy.

The Antarctic Treaty is due to be ratified in 1991. The Kansas scientists think by that time as much should be known about the Antarctic resources as possible. "The treaty will be best agreed upon in knowledge instead of ignorance," says Dr. Zeller.

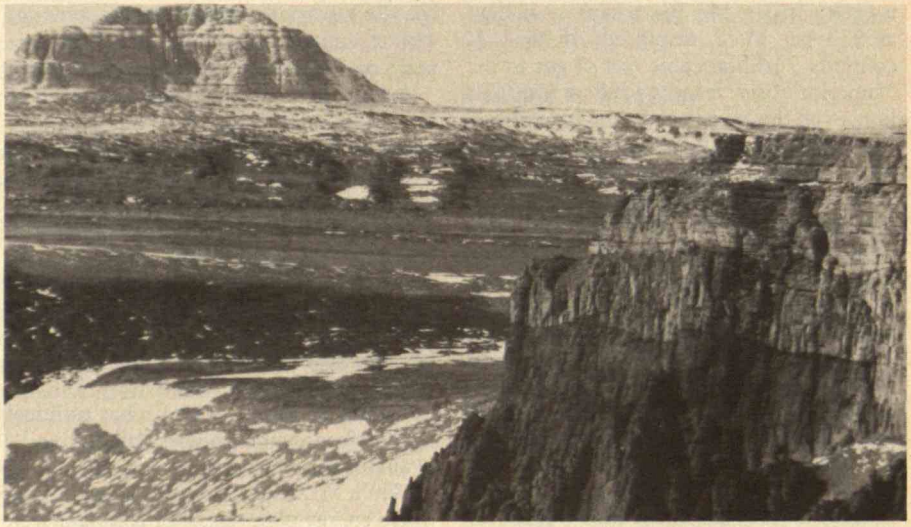
Still, a number of researchers "on the ice" think it a mistake to support this sort of research. "We would be out of the frying pan and into the fire," says one glaciologist. "I'd faint," replied an N.S.F. assistant director when asked what he would do if a vein of high-grade uranium was discovered.

Exploration or Exploitation?

During the last 15 years, international cooperation in Antarctica has been exemplary. Under the terms of the treaty, nations can inspect one another's bases and must publish the results of their research in scientific journals.

According to U.S. sources, all the nations appear to be abiding by the conditions. But there are signs that the potential wealth of the ice-locked continent is putting appreciable strain on this cooperation. When a confidential U.S. Geological Survey estimate that the Antarctic shelf may contain 45 billion barrels of petroleum and 115 trillion cubic feet of natural gas became public, it created an international stir. Since then, the treaty nations at their biennial meetings have begun to discuss how to deal with resource exploitation.

(Continued on p. 80)



The dry valley region of Victoria Land, Antarctica, is being prospected for uranium. The dark band on the cliff in the foreground is similar to sandstone mined for uranium in the western U.S. Uranium is only one of the resources that threatens to turn Antarctic exploration to exploitation, jeopardizing international scientific cooperation in the bargain. (Photo: David F. Salisbury)

Books and Comments

Inventive Minds

Fire of Genius: Inventors of the Past Century
Ernest V. Heyn, in collaboration with Alden P. Armagnac, Arthur Fisher, Devon Francis, and C. P. Gilmore
Garden City, N.Y.: Anchor Press/ Doubleday, 1976, 352 pp.; $12.95

Reviewed by Volta W. Torrey

A blind man who admired Herbert Spencer founded *Popular Science* as a philosophical journal in 1872. Early in this century it evolved into a highly illustrated "how-to" magazine with a mass circulation. In recent years, it has become slightly more technical and has continued to prosper.

For several decades *Popular Science* stressed inventors' personalities and was written to be inspirational to inexperienced inventors. *Fire of Genius* is written and organized in similar fashion. Its author, Ernest V. Heyn, was Editor of *Popular Science* from 1964 to 1970. He has mined its bulky files with the help of Alden P. Armagnac, the oldest member of the staff, and other writers for that magazine, and supplemented this with tidbits of information found in other publications.

The book's title is drawn from an address that Abraham Lincoln gave in 1859 acclaiming the patent laws, and the book ends with a chapter of advice about how to get a patent. Washington, Jefferson, and other early American inventors had not patented their devices; Lincoln was our only President who ever held a patent, and his was on pneumatic tubes to float a riverboat off sand bars.

Mr. Heyn reminds us of many more successful inventors of "tremendous trifles," e.g., barbed wire, the typewriter, the zipper, cellophane, nylon, and the Jonny Mop. He tells us about the "Lady Edison" who devised machinery to make flat-bottomed paper sacks for our groceries, and notes how greatly such things have changed our daily lives. He then devotes whole chapters to Alexander Graham Bell, Thomas Edison, the Wright brothers, and Charles M. Hall, the "alchemist of aluminum." George Eastman, Edwin Land, Guglielmo Marconi, and Lee DeForest, share the author's attention in other chapters.

The profile of Edison notes that he believed all his life that something snapped in his head when a brakeman grabbed him by his ears to yank him onto a moving train and caused his deafness. Mr. Heyn also reminds us that Edison let a report circulate that he was working on a loudspeaker for receiving spirit messages, but later dismissed that story as a joke.

Nicola Tesla is hailed as "the man who invented the twentieth century," and Arthur Brisbane's description of him is quoted: "His head is shaped like a wedge. . . . He lives his life in the top of his head, where ideas are born, and up there he has plenty of room." Fantasies as well as momentous ideas were born in that head. Mr. Tesla thought, for instance, that he could so increase the electrical potential of the earth that anyone anywhere could easily draw current directly from it, and J. P. Morgan financed Tesla's futile attempt to do so.

The chapter about the Wright brothers reviews the doubts and controversies their first flight produced, and notes both brothers' failure to marry. Wilbur's finesse of a request for him to speak at a dinner honoring him in Paris is cited here: "I know of only one bird, the parrot, that talks, and it can't fly very well."

After holding one's attention with such details from lives of the inventors who interested Mr. Heyn most, he includes a long chapter of sketches of many more "lest they be forgotten": Daimler, Diesel, Roentgen, Mergenthaler, Fermi and Szilard, Sikorsky, Kettering, Armstrong, Goldmark, Townes, Evinrude, Godowsky and Mannes, Sperry, and Westinghouse. Some are memorable for many achievements, others for only one; some were generously rewarded for their work, others poorly. Their personalities, approaches, and methods varied widely, yet all seem to have been adherents to the motto on M.I.T.'s seal, *mens et manus,* with the energy and determination needed to solve problems that many of their contemporaries considered unsolvable.

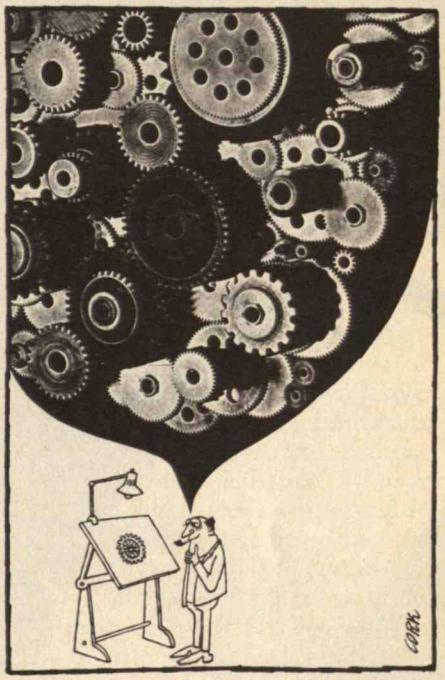


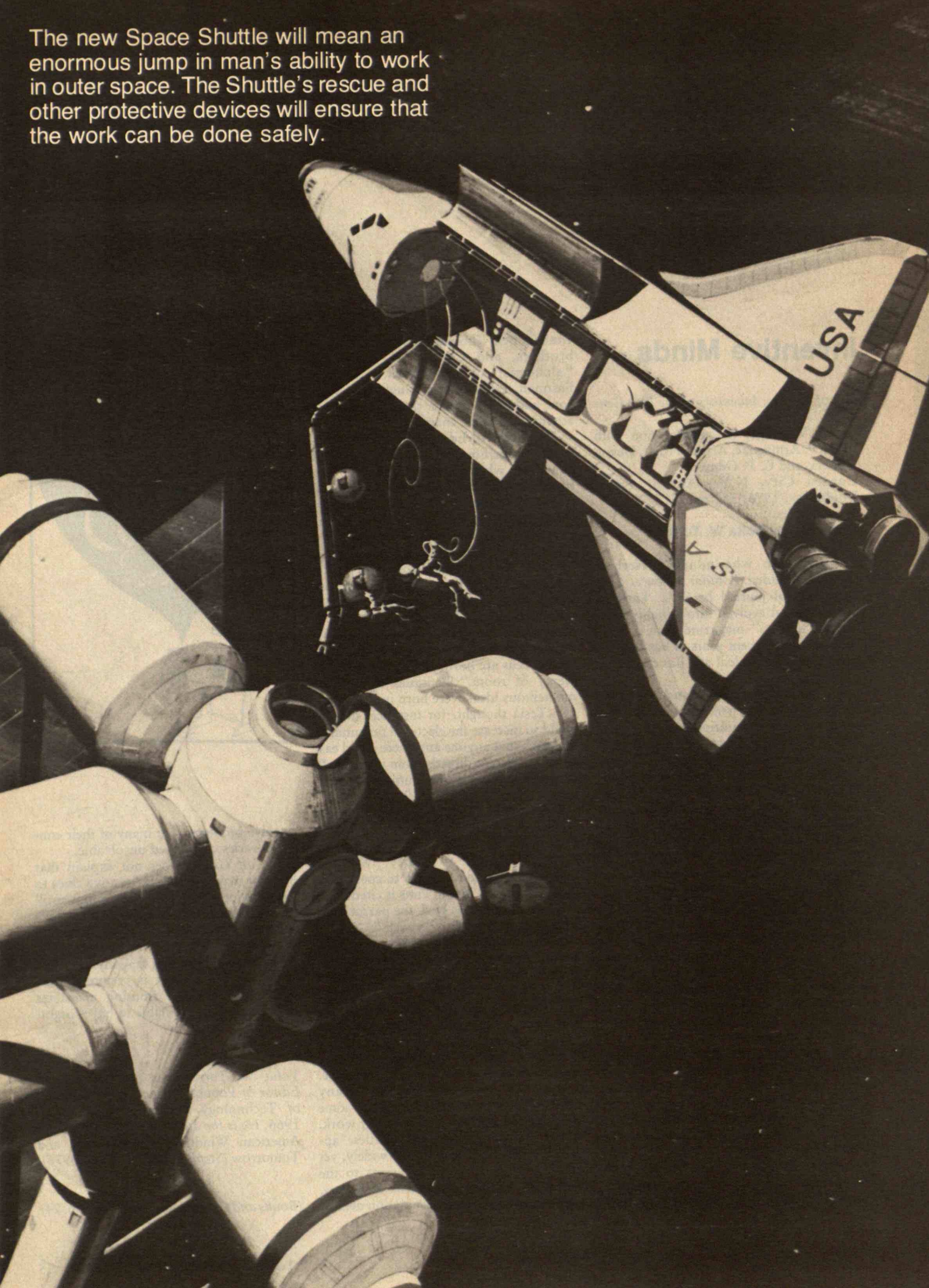
Illustration by CORK

Fire of Genius does not explain that fire, but may contain provocative clues to its behavior. The book is like a first stroll through the Smithsonian Institution's Museum of History and Technology in Washington. It is easy to skim or study. And although the book may say little that is new to scholars, it is crammed with dramatic and often amusing anecdotes that many of us are liable to have forgotten.

Volta W. Torrey was for many years Editor of Popular Science; *he was Editor of* Technology Review *from 1959 to 1966. He is the author of* Wind Catchers: American Windmills of Yesterday and Tomorrow *(Stephen Greene Press, 1976).*

(Books and Comments continued on p. 74)

The new Space Shuttle will mean an enormous jump in man's ability to work in outer space. The Shuttle's rescue and other protective devices will ensure that the work can be done safely.



Nelson E. Brown
McDonnell Douglas
Technical Services Co.

The Safe Shuttle

Along with the beneficial and thrilling achievements in the short history of manned space flights, sad pages have already been written. The tragic deaths of astronauts in the 1967 Apollo fire and the Soviet Soyuz 1 and 11 disasters (*see box, page 22*) have demonstrated the real risk of serious accidents in space flight. The Space Shuttle, this country's new earth orbital workhorse, employs a host of systems and techniques to make space a safer place to experiment, work and permanently inhabit in the not-too-distant future. In fact, most people do not realize that, besides the new opportunities for less-expensive space research and industrialization, the Space Shuttle offers new opportunities for space rescue, without which the exploitation of outer space simply couldn't proceed. The past mishaps which have jeopardized missions and astronauts in previous U.S. space programs have instigated rigorous safety policies now being applied to the Space Shuttle, and the Shuttle is considered the safest of all manned space vehicles designed to date.

A New Answer to a New Problem

United States spacecraft preceding the Space Shuttle were each designed for a single mission and were formally retired following return to earth. The Shuttle, due for its initial orbital mission in March, 1979, presented an entirely new problem. Crew safety was a top-priority as always, but each Orbital vehicle had to be protected from damage for its planned 500 missions.

The Space Shuttle system consists basically of a reusable Orbiter vehicle, which accommodates the crew and payload, an external tank that contains the ascent propellant for the Orbiter engines, and two solid-fuel rocket boosters for liftoff assistance *(see page 18)*. The Orbiter vehicle, similar to a high-performance aircraft, provides a dual-level crew cabin and a bay for experiments and payloads. The vehicle is equipped for reentry from space, cross-range non-powered flight to a landing area, and an aircraft-type wheel landing.

The Orbiter can accommodate experiments and payloads up to 60 feet long and 15 feet in diameter in the payload bay. Payloads weighing up to 65,000 pounds can be delivered to a low earth orbit, while higher orbits can be attained by using one of several booster vehicles attached to the payload and deployed from the Orbiter through two payload bay doors. Payloads will include satellites, various scientific experiments to be performed in orbit, deep-space probes, and space laboratories. The Shuttle will also retrieve, repair and refurbish satellites.

The Orbiter flight crew of four to seven persons consists of a commander, a pilot, a mission specialist, and one to four payload specialists as operations warrant. A normal mission will last seven days; various extension kits with extra food, fuel, oxygen, etc. will allow extension of missions to a maximum of 30 days.

The Orbiter crew compartment consists of two levels: an upper-level flight deck and a lower level containing sleep areas, a galley, personal hygiene and exercise facilities, and provisions for off-duty activities *(see page 18)*. The forward area of the flight deck is dedicated to Orbiter flight operations, while the aft area includes the crew stations for on-orbit flight control, rendezvous and docking, and payload manipulation and operation.

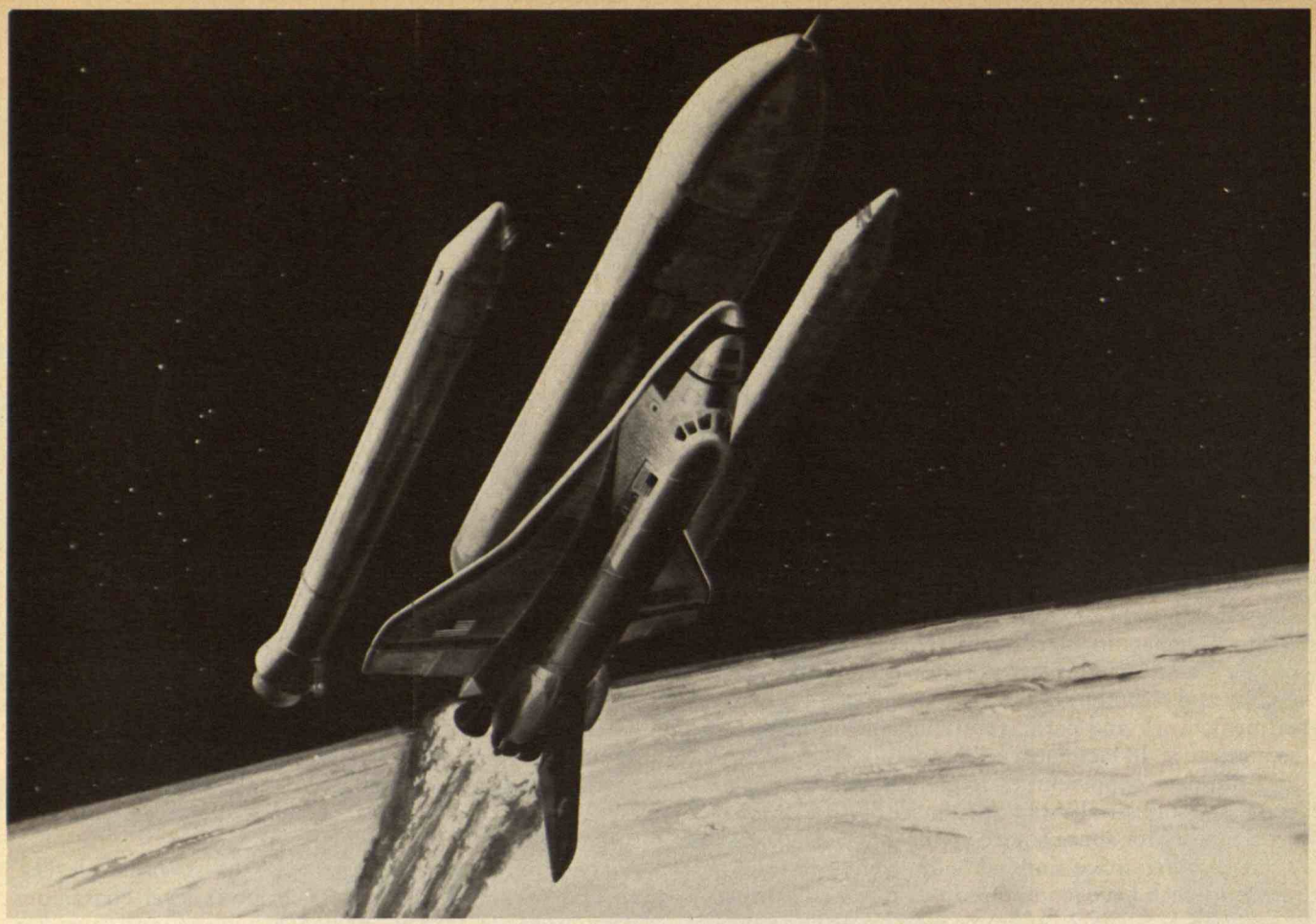
Crew access to the unpressurized payload bay and Orbiter exterior is through an airlock on the lower deck. A cabin side hatch on the lower deck allows ground operations access and will serve as a contingency exit when in orbit.

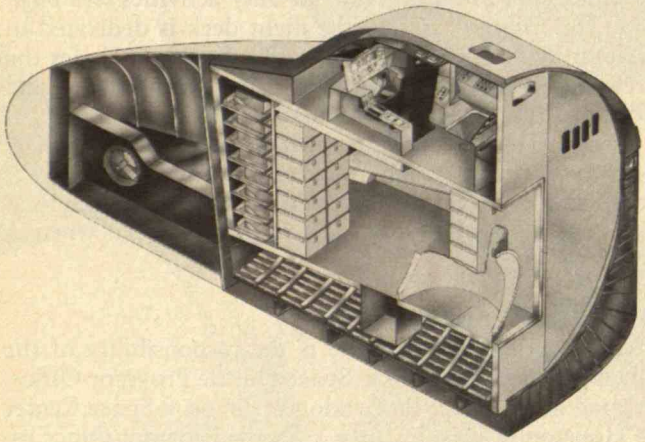
A "Fail-Operational" Philosophy

Flight safety for the Shuttle is the responsibility of the Manager of Flight Safety, Space Shuttle Program Office, located at the N.A.S.A. Lyndon B. Johnson Space Center in Houston, Texas. In early 1974 the Program Office established a formal Space Shuttle Crew Safety Panel as a mechanism for analyzing all activities of the Shuttle Program to identify conditions which may be hazardous to onboard personnel and Orbiter systems. The panel, consisting of qualified technical experts, is concerned with each Shuttle operational phase including mission preparation, flight tests, ground operations, launch, orbital payload handling, reentry, landing and ditching.

N.A.S.A.'s overall safety plan for the Space Shuttle has been continuously to identify potential hazards early in development programs and to ensure that each hazard is either eliminated or reduced to acceptable safety levels. The basic Shuttle safety goal is to design all critical systems to be "fail-operational" — that is, able to sustain failures and yet retain full operational capability so that the mission can be continued. Where this fail-operational objective cannot be achieved due to schedules, cost, or

The Shuttle Remote Manipulator System will be normally used to deploy and retrieve payloads while on-orbit. However, it can also be used in space rescue, transferring crewmen to the rescuing vehicle, or being attached to the disabled vehicle to give crewmen a pathway to the rescuer. (All photos courtesy of N.A.S.A.)





Above:
The Space Shuttle System consists of a reusable Orbiter vehicle, which accommodates the crew and up to 60-foot-long payloads; an expendable external propellant tank for the Orbiter main engines; and two reusable solid-fuel rocket boosters for liftoff assistance. Only the Orbiter is launched into earth orbit.

Left:
A cutaway view of the Orbiter crew compartment shows the upper flight deck for Orbiter and payload operations and the lower deck containing sleep areas, galley, personal hygiene facilities, exercise accommodations and off-duty activity provisions. The cabin can accommodate seven crewmembers in the usual operational mode and ten in a rescue configuration.

mission objectives, the minimum design goal is for "fail-safe" systems, meaning that though the system may fail, the flight may be successfully terminated without injury to the crew. In both cases, the primary goal is that vehicle and equipment malfunctions do not jeopardize the safety of the crew.

To make Shuttle systems fail-operational or fail-safe, designers have specified full redundancy in critical systems; dissimilar elements as a back-up capability; warning devices; and high-reliability hardware. Furthermore, equipment to be operated by the crew has been carefully analyzed for ease and accuracy of operation.

The Orbiter power systems offer examples of the redundancy built into critical Shuttle components. Electrical power for the Orbiter is generated by three fuel cells, each of which is connected to one of three independent electrical busses. Hydraulic power is supplied from three independent hydraulic pumps, each driven by its own power unit and cooled by its own water boiler. Any one of these hydraulic systems can actuate Orbiter controls.

An example of dissimilar elements to provide back-up capability is the provision of both electrical and manual methods to actuate the Orbiter payload bay doors: should the eletrical system malfunction, a space-suited crewman can open or close the doors mechanically.

Both audio and visual warning devices will alert the crew to dangers such as fire, rapid cabin pressure loss, avionics malfunctions, fuel depletion, and abnormal vehicle temperatures.

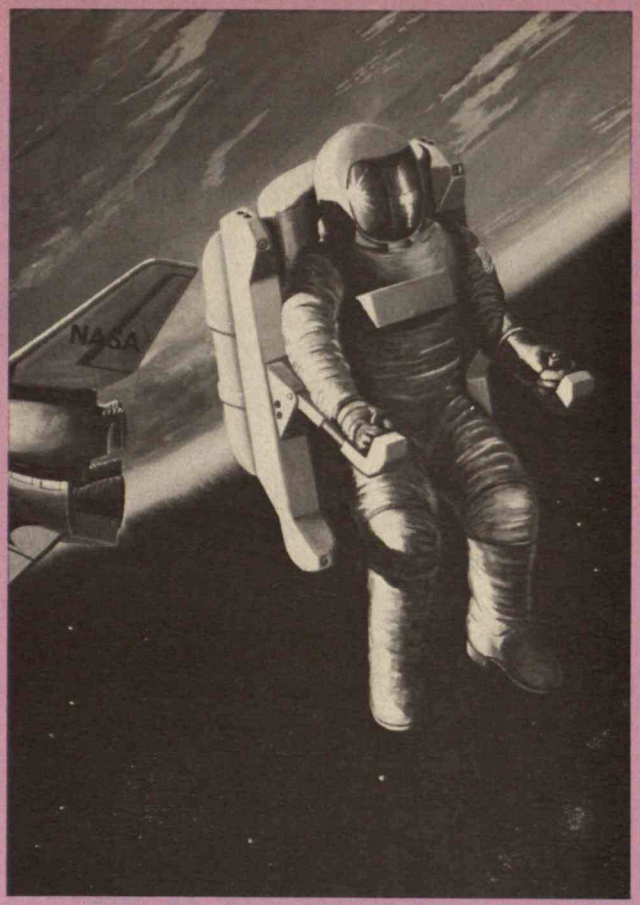
High reliability in hardware is achieved by subjecting all Shuttle elements, from small individual components to critical controls and displays, to extensive testing and

A One-Man "Spaceship" Allows Free Flight

To allow space-suited crewmembers to operate in space independently of the Shuttle Orbiter, N.A.S.A. is currently developing the "Manned Maneuvering Unit" (MMU). With the self-contained, free-flying backpack, crewmembers will be able to more freely inspect and repair Orbiter exterior systems, service payloads that cannot be docked to the Orbiter, and rescue personnel from a disabled craft. Two such maneuvering units can be mounted in the payload bay of each Orbiter, to be rapidly donned by crewmembers wearing space suits. The unit, controlled by the crewmember using two hand controllers (rotational and translational) located on extendable arms, is maneuverable in all directions. An automatic attitude hold capability using gyroscopes is designed into the unit. The MMU also includes a manual backup attitude hold capability.

The unit is propelled by pressurized nitrogen contained in storage tanks and expelled through 20 small thruster devices — the hand controllers directing the pressurized nitrogen to the appropriate thrusters for the desired motion. Two completely independent propulsion systems are provided on the unit to enhance crew safety.

Each MMU is capable of supporting extravehicular operations for up to 6½ hours and can be recharged from Orbiter supplies. Electrical power outlets are provided on the units to power cameras, lights, tools and scientific instruments. The MMU operations early in the Shuttle Program will be limited to a radius of 300 feet from the Orbiter. Future plans include navigation aids and additional propellant for longer range maneuvering unit operations and also maneuverable platforms to use in assembling large space stations. — *N. B.*



quality assurance programs.

The design emphasis on human engineering is reflected, for example, in the Orbiter avionics system: equipment is arranged to allow crewmembers to reach, operate, check out and replace each system with minimal disturbance to other systems, and controls are located to minimize their inadvertant actuation.

These design guides and extensive N.A.S.A. training and testing programs currently being implemented should result in a versatile, operational space transportation system with highly effective capabilities for crew protection and space rescue.

The Human as a Safety System

One of the most important safety factors in the Space Shuttle will be a well-trained crew. Accordingly, N.A.S.A. has developed a training aircraft that simulates the subsonic flight characteristics of the Orbiter. The training aircraft can match the Orbiter atmospheric descent trajectory from 35,000 feet to a "touchdown" 22 feet above the runway. The trainer is a Grumman Gulfstream jet modified to give Space Shuttle pilots a realistic reproduction of Orbiter cockpit motions, visual cues, and handling qualities.

To duplicate the non-powered handling characteristics of the Orbiter, the Gulfstream was modified to include additional control surfaces and modified inflight thrust reversers. Such alterations, combined with an extended main landing gear, serve to simulate the rapid Orbiter descent of 12,000 feet per minute at a 24° flight path. These control surfaces and other equipment are controlled by a computer which contains a mathematical model of the Orbiter's flight characteristics. When a pilot makes a control input into the trainer, the computer compares the jet's response with the Orbiter's hypothesized response and external equipment on the trainer is then adjusted to eliminate the response differences. Under such circumstances, the trainer could also present crew hazards since unusual aerodynamic configurations must be attained to match the Space Shuttle's characteristics. To eliminate or control these possible hazards, N.A.S.A. engineers have provided for rapid disengagement of the computer and quick return of the aircraft to its standard control configuration.

Testing the Dead-Stick Landing

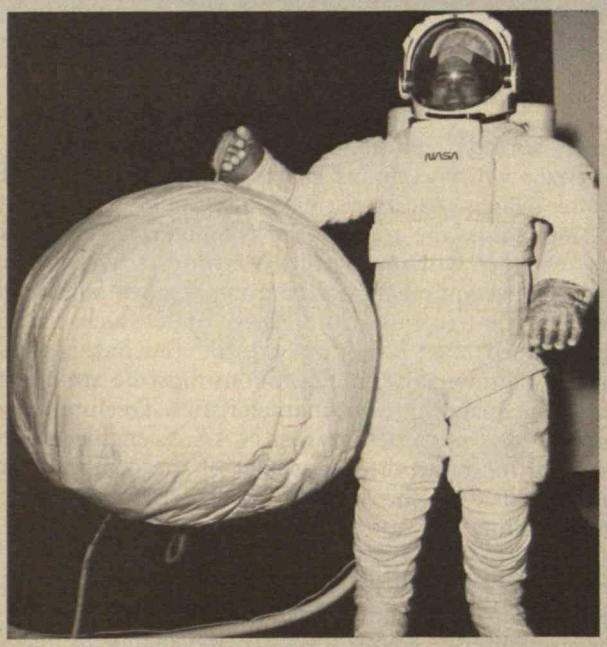
Upon reentering the earth's atmosphere, the non-powered Shuttle Orbiter has only one chance to make a safe, normal landing; hence, all landing operations must be carefully tested since no "go-around" capability exists in a "dead-stick" landing mode. Before the first orbital mission, the Orbiter will make at least 11 subsonic flights to check out all approach and landing systems. During 1977, the Orbiter will be carried aloft atop a modified Boeing 747, and released at an altitude of 20,000 feet to glide to a non-powered landing. The program will test not only pilot-guided approaches and landings, but also the automatic landing systems in the Orbiter. Besides determining the general subsonic airworthiness of the Orbiter, the tests will also include various landings with dif-

The Personnel Rescue System: "The Space Egg"

Each crewmember on flights of the new Space Shuttle will be provided equipment for extravehicular transfer to a rescue vehicle in emergency situations. The pilot and mission specialist will be equipped with space suits containing life-support systems capable of about seven hours of operation. All other crewmembers will have "Personnel Rescue Systems," which consist of 34-inch diameter pressure enclosures, portable life-support systems and liquid cooling vests.

The portable life-support system consists of a pressurized oxygen bottle with appropriate valves and regulators. The liquid cooling vest is a loosely woven garment with an array of small tubes which contact the skin and through which water is circulated to remove body heat.

Should an emergency require transfer to a rescue vehicle, a crewmember would don the liquid cooling vest and life-support system, and enter the sphere through a zipper opening. The sphere would then be pressurized from the Orbiter oxygen supply and the cooling vest activated. The sphere would use oxygen and liquid cooling from the Orbiter until ready for transfer from the disabled vehicle, and during actual transfer a face mask attached to the portable life support system would provide breathing oxygen and maintain pressure inside the sphere. The life-support system could provide oxygen for a minimum of one hour, during which the occupant would be essentially a passive element in the transfer, depending solely on the crewmembers with space suits to perform the rescue. —*N.B.*



In the Shuttle era, crewmen aboard a disabled vehicle or space station will be ferried to a rescue craft via spherical personnel rescue enclosures. They will crouch inside, wearing breathing masks and cooling vests, while space-suited crewmen effect the transfer.

ferent gross weights and center-of-gravity conditions.

The Orbiter vehicles used to conduct the approach and landing tests and the earlier orbital flights will incorporate special safety provisions, including aircraft ejection seats, blowout panels for emergency ground exit, and special survival kits for astronauts forced to make emergency landings.

If a Launch Goes Wrong

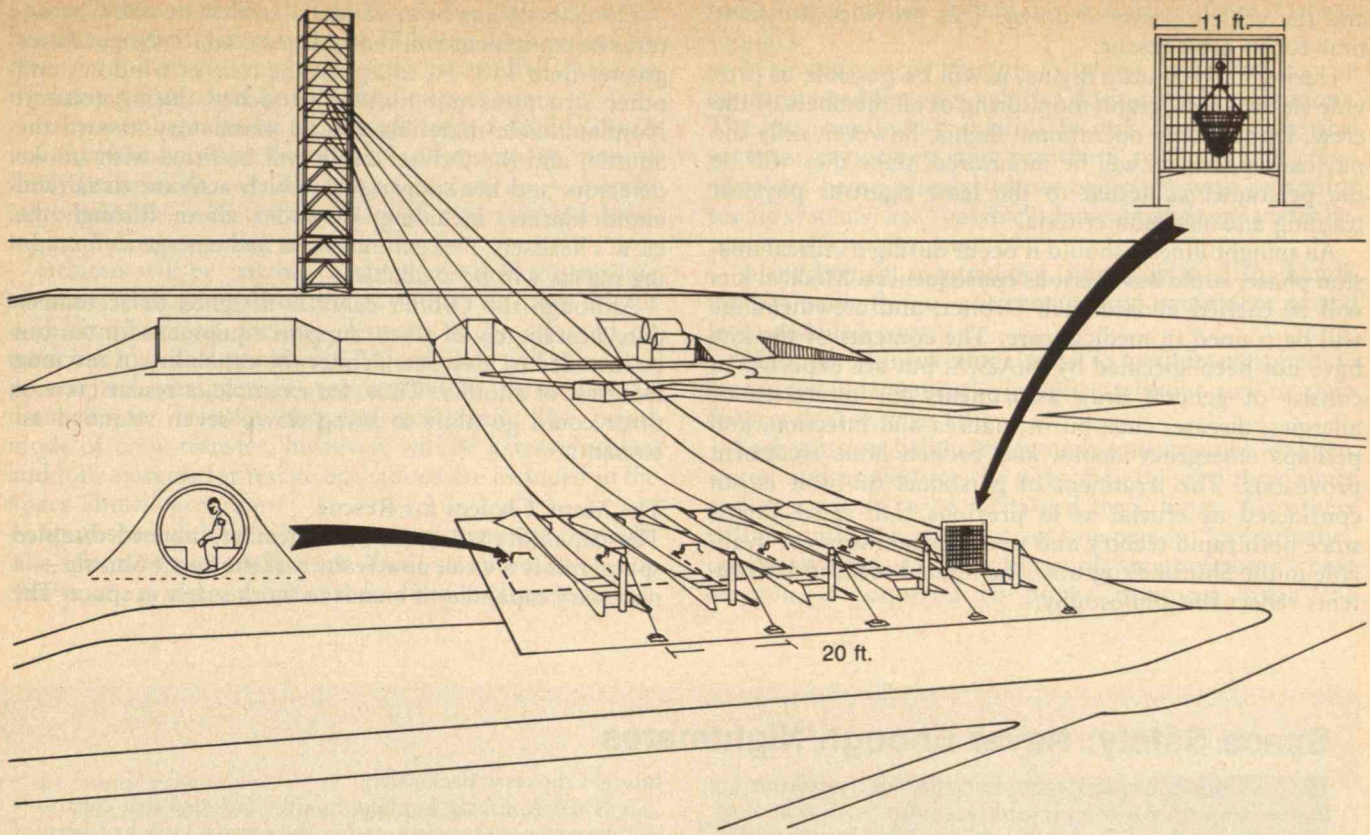
The Shuttle launch pad will feature a slide-wire system for rapidly removing a crew from the pad in case of an emergency. The system, shown at the right, consists of five slide wires extending from the launch tower to ground bunkers about 1,200 feet from the base of the tower. Each slide wire supports two wire baskets, each of which would carry a single crewmember down the wire to safety bunkers. Nets are provided in the event of a basket overrun. Using the slide wires, the entire crew of the Shuttle could be evacuated to the bunkers in less than two minutes. The launch tower stairs could also be used for evacuation.

Once the Space Shuttle is launched, several "intact abort" modes are available to allow the Orbiter to return safely to a landing site in case of failures. Intact aborts are designated as either return-to-launch-site (RTLS) or abort-once-around (AOA). The RTLS abort will be used if the altitude and speed at the time of malfunction are insufficient to attain orbit. If orbit is attained before the failure, it will probably be a lower orbit than desired to continue the mission, and the Orbiter will reenter and land after one revolution around the earth. Such "once-around" aborts will be possible from the time the Orbiter has separated from its boosters and external fuel tank to the time the specified earth orbit is reached. An abort may be required if one Orbiter main engine suffers complete or partial loss of thrust, or if one on-orbit maneuvering thruster is lost.

For more serious problems, such as loss of thrust from two or three Shuttle engines, vehicle control failures, or premature separation of the Orbiter from the fuel tank — a "contingency abort" would be necessary — implying that the crew would be safely returned by an emergency landing or water ditching although the Orbiter itself might suffer damage or even be lost. The primary "contingency abort" mode now being studied by N.A.S.A. is based on jettisoning the large fuel tank during the launch, with the astronauts gliding the Orbiter to a downrange ditching or to a runway landing if an emergency site is available. Since the solid rocket boosters are attached to the fuel tank (not the Orbiter), they are also jettisoned, leaving only the unpowered Orbiter to accomplish an emergency landing. There is some risk of the Orbiter's colliding with the fuel tank, but other abort options may not exist in certain situations, depending on vehicle speed, altitude, and attitude during the launch phase.

Certain serious failures during launch would almost certainly either seriously damage or destroy the Shuttle system. These include:

— External tank rupture or explosion,
— Solid rocket booster burning through its casing,
— Major structural failure,
— Complete loss of guidance or control,
— Failure to ignite one solid rocket booster,
— Loss of thrust from one solid rocket booster,
— Shuttle main engine or thrust vector control locked in an abnormal attitude,



A slide-wire basket system from the launch pad to bunkers allows the crew to escape the launch pad in less than two minutes. A secondary egress route is via the launch tower stairs.

— Engine nozzle failure,
— Failure of external tank to separate from Orbiter,
— Premature separation of either or both solid rocket boosters.

The possibility of such serious failures is, of course, being minimized by incorporating appropriate safety margins and redundancy in the design of Orbiter systems, functions, and operations critical to crew safety. Extensive tests under all feasible failure conditions are also being conducted on the critical systems. Such tests may include structural, pressure, thermal, vibration, acoustic, vacuum, and combinations of the above.

As with commercial aircraft flights, there will be critical times during any Shuttle flights in which very little escape or rescue capability exists regardless of the safety provisions incorporated. No space program can be risk-free. To eliminate or control all hazards identified in the Shuttle Program is a major program in itself. A certain level of risk must be accepted to achieve the Space Shuttle objectives; N.A.S.A. accepts these minimum risks in return for the potential benefits.

The Shuttle Program also includes precautions to protect the public in the vicinity of Shuttle launch operations. The boosters will be parachuted to preselected, remote sites in the Atlantic and Pacific Oceans, and the external tank will be jettisoned from the Orbiter for impact at a site at least 200 nautical miles from any land mass (normally in the South Pacific or Indian Oceans). Should a propulsion failure occur during launch, the boosters can be destroyed upon a coded radio signal from the ground, and the external fuel tank can be made to jettison its fuel before impact. None of these operations will require action from the crew.

The Safe Cabin

The Orbiter crew will be able to fully control the flight of the vehicle; to monitor and control both onboard Shuttle subsystems and payloads; to detect and correct such hazardous conditions as fires and cabin depressurization; to monitor and maintain the cabin atmosphere (e.g., temperature, pressure, humidity, toxicity); to guard against water and food contamination; and to override aborts initiated from the ground. Controls in the Orbiter have been carefully located and designed to reduce the possibility of human error in their operation, and both visible and audible alarms will warn of malfunctions or hazards. The reliability and quality of foodstuffs for Shuttle crews will be guaranteed by vacuum packing under microbiological limits which are stricter than those applied to commercial products. To ensure good housekeeping in a closed spacecraft, biologically-active food leftovers will be treated with a bacteriostatic agent. As with all previous manned spaceflights, Shuttle drinking water will be stored in tanks large enough for the entire mission. Water quality will be measured periodically and, as required, water will be treated with chlorine or a similar substance.

Should the Orbiter cabin depressurize for any reason, the life-support system will provide ample resources for cabin repressurization. The life support system will also be able to maintain a viable cabin pressure and expendables to support a crew of seven for 165 minutes against a leakage rate equivalent to a hole approximately one-half inch in diameter; this is enough time for the Orbiter to land.

Should an accident strand an Orbiter in earth orbit, there are enough expendables to support a crew of four for 96 hours with the crew at a resting level of activity,

and the vehicle powered down. This provides sufficient time for in-orbit rescue.

During early Shuttle flights, it will be possible to provide electrocardiograph monitoring of all members of the crew. During later operational flights, however, only the payload specialists will be monitored, since they will be the personnel subjected to the least rigorous physical training and selection criteria.

An inflight illness, should it occur during a critical mission phase, could have serious consequences. Medical kits will be carried aboard each Orbiter, and crewmembers will be trained in medical care. The contents of the kits have not been specified by N.A.S.A. but are expected to consist of general drug assortments for treatment of allergies, disease, cuts, burns, nausea and infection, and perhaps emergency dental and broken bone treatment provisions. The treatment of personnel on-orbit is not considered as crucial as in previous U.S. space flights since both rapid reentry and rescue capabilities are available in the Shuttle Program. The limited medical kit contents reflect this philosophy.

The Shuttle has been designed so that no cabin structures or equipment will reach direct contact temperatures greater than 113° F., except in the case of windows and other structures not normally touched during reentry. Nonflammable materials will be mandatory aboard the Shuttle, and the Orbiter cabin will be fitted with smoke detectors and fire suppressors which activate visual and audio alarms, including an audio alarm through the crew's headsets. Fire extinguishers and emergency breathing masks will be available.

Although the Orbiter cabin is designed to accommodate a total crew of seven, support equipment for ten can be installed to give one Orbiter the capability of rescuing the crew of another. Thus, for example, a rescue crew of three could go aloft to bring down seven stranded astronauts.

The Many Choices for Rescue

The capability to rescue crewmembers aboard disabled spacecraft is a vital, new feature of the Space Shuttle — a necessary capability if man is to work safely in space. The

Space Safety: Never Enough Nightmares

Those who engineer spacecraft and their safety systems are doubly cursed by a complex, ultrasophisticated technology and an unforgiving, alien environment with which they have precious little experience. Their job is to conjure nightmares of disasters in space, and use those nightmares to build systems that will avoid them or allow an escape. But the engineers must always live with the possibility that they have overlooked a possible nightmare; that they will find themselves meticulously analyzing a resulting agonizing tragedy, to dredge up all the "should-haves" and "could-haves" in the full knowledge that even this may not be enough to guard against future disasters.

On January 27, 1967, three Apollo astronauts perished in a launch pad fire, in which an electrical arc of undetermined origin ignited flammable materials in the space capsule. The flash fire, intensified by the pure-oxygen atmosphere of the spacecraft produced carbon monoxide and other fumes which poisoned the astronauts — Virgil Grissom, Edward White and Roger Chaffee — before they could open the escape hatch. After the fire N.A.S.A. instituted numerous design changes to avoid such future tragedies. The hatch was re-engineered for quick escape and combustible materials were replaced in space suits, wire connections, and switches. The cabin atmosphere was changed from 100 per cent oxygen to a 60-40 mixture of oxygen and nitrogen. And an emergency oxygen system was installed that could isolate the crew in case toxic fumes began to fill the capsule.

In spite of the many design changes, the accident still haunts the space program, a stark reminder to engineers that the marks on their drawing boards or the systems they install might mean life or death.

But even if every part of every system were designed perfectly, there would still remain those malfunctions due to overlooked defective components. It was just such a flaw that almost cost the lives of the Apollo 13 astronauts. On April 13, 1970, the mission to the moon was launched without a hitch, but on the third day out an explosion in the service module's oxygen tank forced the three astronauts, James Lovell, John Swigert and Fred Haise, to travel a perilous loop around the moon and back to earth — their oxygen and power ebbing dangerously low. Only hastily devised strategies for using oxygen supplies aboard the lunar module brought the crew back safely.

A N.A.S.A. accident review board concluded that electrical instrumentation wires within the oxygen tank had been inadvertently damaged during ground testing, and that the damage, invisible from the outside, had escaped detection. The ignition of the Teflon-coated wires led to a pressure buildup and subsequent rupture of the oxygen tank. A number of design changes were implemented in hardware and procedures to prevent such a problem in the following Apollo flights.

Human error, of course, is another factor beyond the control of any design engineer. On the joint U.S.-Soviet space mission in 1975, the three Apollo crewmen — Thomas Stafford, Donald Slayton and Vance Brand — narrowly escaped death in the final phase of their mission. During reentry, when certain switches were not activated on time, products of combustion and fuel oxidizer were allowed to enter the spacecraft via cabin pressure relief valves. The crewmen suffered from eye and lung irritation and were hospitalized for about two weeks following splashdown.

But even flawless design engineering, flawless inspection techniques and human performance, in the end, are not enough. There will still be those elusive, random gremlins in systems that don't reveal themselves until an actual operation coaxes them out of hiding. In 1967 Russian cosmonaut Vladimir Komarov was killed when his Soyuz 1 spacecraft's parachute became tangled upon deployment. And in 1971, Soyuz 11 cosmonauts Georgi Dobrovolski, Vladislav Volkov and Viktor Patsayev died upon reentry, when an apparently imperfect command module seal allowed a rapid drop in cabin pressure. Many, if not most, American spaceflights have been bedeviled by more minor random malfunctions, from spacecraft docking mechanisms that wouldn't dock to computers that suddenly refused to compute and television cameras that went blind.

The Space Shuttle will certainly contribute its share of problems, and while many will come from totally unexpected quarters, some unknown areas of operation are being examined particularly carefully.

Dr. John F. McCarthy, Jr., Director of M.I.T.'s Center for Space Research and a long-time participant in the space program cites three development problems being addressed in

Space Shuttle provides that such a rescue mission can be launched within a maximum of 24 hours after orders are given, and a rescue vehicle already in standby status on the launch pad could be launched in two hours.

Crewmembers can be transferred from a disabled craft in either of two ways: by extravehicular activity, moving freely between the two adjacent spacecraft, or — if docking is possible — by transfer through a pressurized docking module connecting the two vehicles.

Orbiters will be capable of carrying a docking module to mate with other Orbiters, as shown on page 24, or with standardized docking elements to be adopted on most international spacecraft. This module will provide a pressurized passageway approximately three feet in diameter for transfer between spacecraft. The prime mode of crew transfer, however, will be extravehicular, and four systems for rescue operations are included in the Space Shuttle program:

— Spacesuits with their life support systems and controls. The spacesuit can operate for about seven hours on one charge of oxygen and one carbon dioxide absorption cylinder, after which it can be recharged from Orbiter supplies.

— Personnel rescue systems in which crewmembers can be transferred between vehicles during rescue operations. The rescue systems consist of 34-inch diameter spherical pressure enclosures, and breathing systems. The crewmembers being rescued (those equipped with personnel rescue systems) are "passive" elements during transfer between vehicles (*see page 20*).

— A mechanical manipulator, normally used for handling payloads, to move astronauts and equipment to and from disabled craft.

— Manned Maneuvering Units to permit crewmen to maneuver independently in space without ties to their spacecraft (*see page 19*).

Each mission will carry enough consumables (oxygen, water, and power) for the airlock to be used three times and space suits to be recharged three times. Also there will be enough oxygen for six one-person "pre-breathe" operations: two to three hours of "pre-breathing" pure oxygen is required to purge nitrogen from the

the Shuttle program:

— Very little is known about the flight characteristics of vehicles at hypersonic speeds at very high angles of attack, as will be experienced by the Shuttle Orbiter upon reentry. Wind tunnel experiments in this regime are limited to small models so that the limited data must be extrapolated to full-scale.

— The Shuttle will be protected from the heat of reentry by about 34,000 insulating silica "bricks" covering the Shuttle. It is still not completely certain that these bricks can withstand the hundreds of reentries required over the planned lifetime of the Orbiter. And Lockheed is currently having difficulty developing the adhesive needed to attach the bricks to the Orbiter's skin that will withstand the temperatures and pressures experienced during reentry.

— In a highly controversial decision, N.A.S.A. eliminated the expensive heavy air-breathing engines on the Orbiter, which would have enabled powered flight in the atmosphere and powered landings. All Shuttle landings, thus, will be "dead-stick" landings, with no way to circle around should the pilot miss his first approach. A series of landing tests will be conducted in which the Orbiter will be carried aloft atop a Boeing 747 and released to glide to a landing. Landing is especially critical because the Orbiter touches down at high speeds — 210 miles per hour — faster than a high-performance fighter plane. In contrast, a DC-9 lands at about 140 miles per hour.

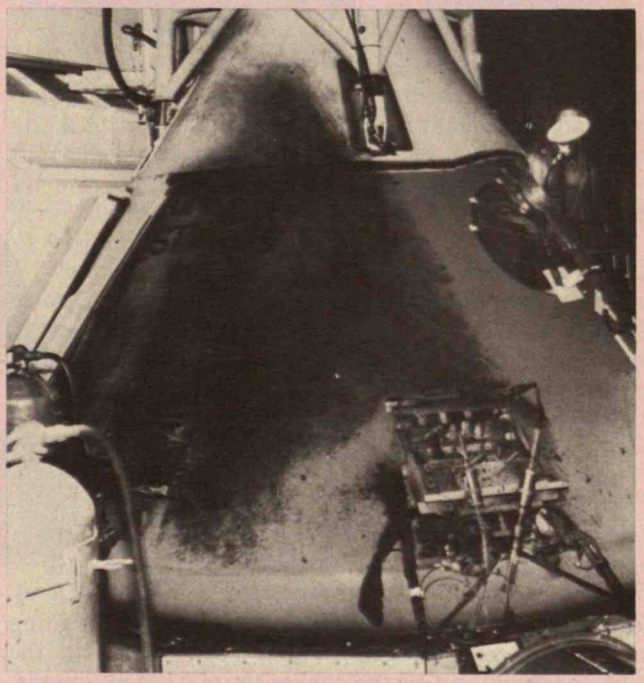
There is also uncertainty in this testing program, because the 747 must dive sharply in releasing the Orbiter. The region between the Orbiter and the 747 when they are flying mated is extremely complex aerodynamically, and not amenable to analysis.

The possibility has been proposed of scheduling all landings at Edwards Air Force Base in California, which is situated on a wide expanse of dry lake bed, giving Shuttle pilots considerable room for landing error.

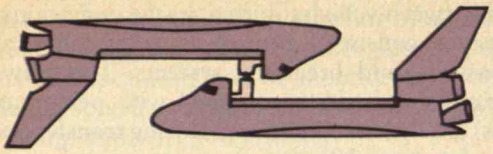
Dr. McCarthy and the other engineers connected with the Shuttle program stress that the unknown areas they are studying by no means represent major safety problems, but are the kinds of routine questions that arise in any such large and complex program.

Planning and debate over safety in space will certainly continue, but in the end the only workable philosophy is the one phrased so succinctly by "Gus" Grissom:

"There's always the possibility that you can have a catastrophic failure," he once said. "Of course, this can happen on any flight. It can happen on the last one as well as the first one. So you just plan as best you can to take care of all these eventualities, and you get a well-trained crew and you go fly." — *D.M.*

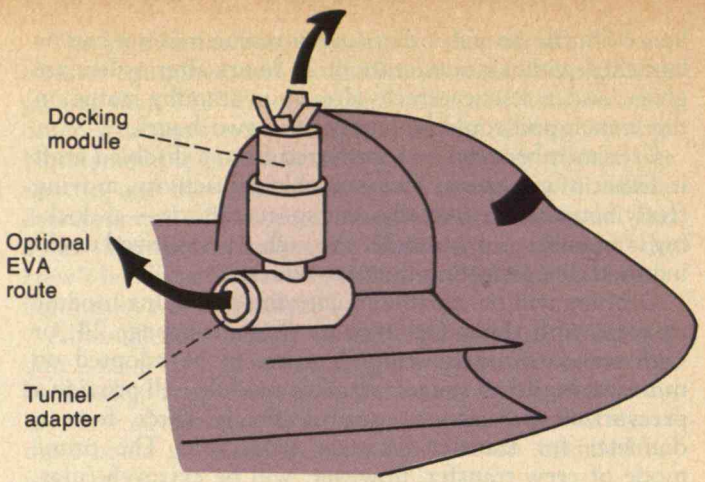


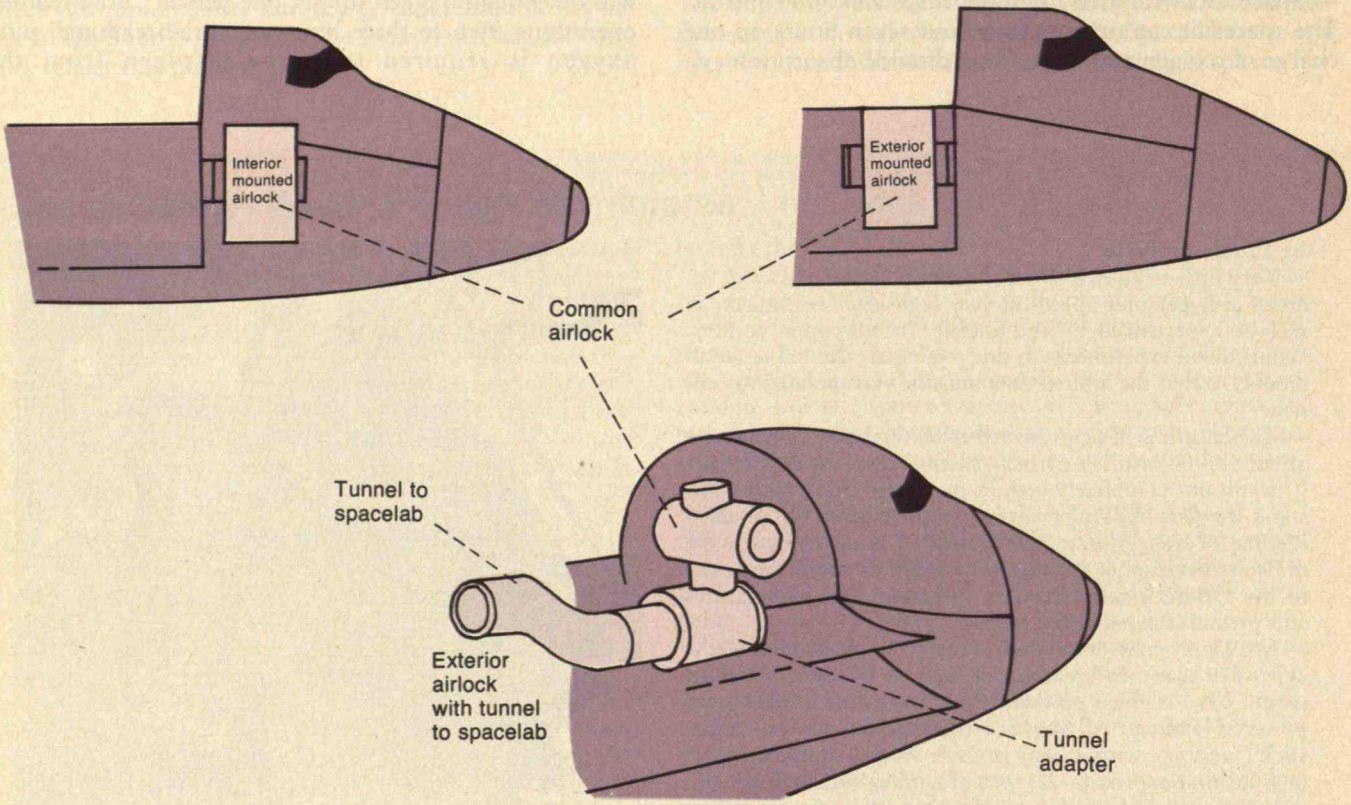
The charred exterior of the Apollo capsule in which three astronauts were killed in 1967. The tragic fire pointed up serious deficiencies in the Apollo safety program.



Above and right:
The Orbiter docking module, with its androgynous docking ring, allows transfer of crewmen between disabled and rescue vehicles during space rescue. Extravehicular transfer is also possible from the tunnel adapter.

Below:
The Orbiter airlock can be positioned in three locations, and provides the usual exit route from the crew cabin into space. Crewmen may also egress to space through the Orbiter side hatch if the cargo bay doors should fail to open.





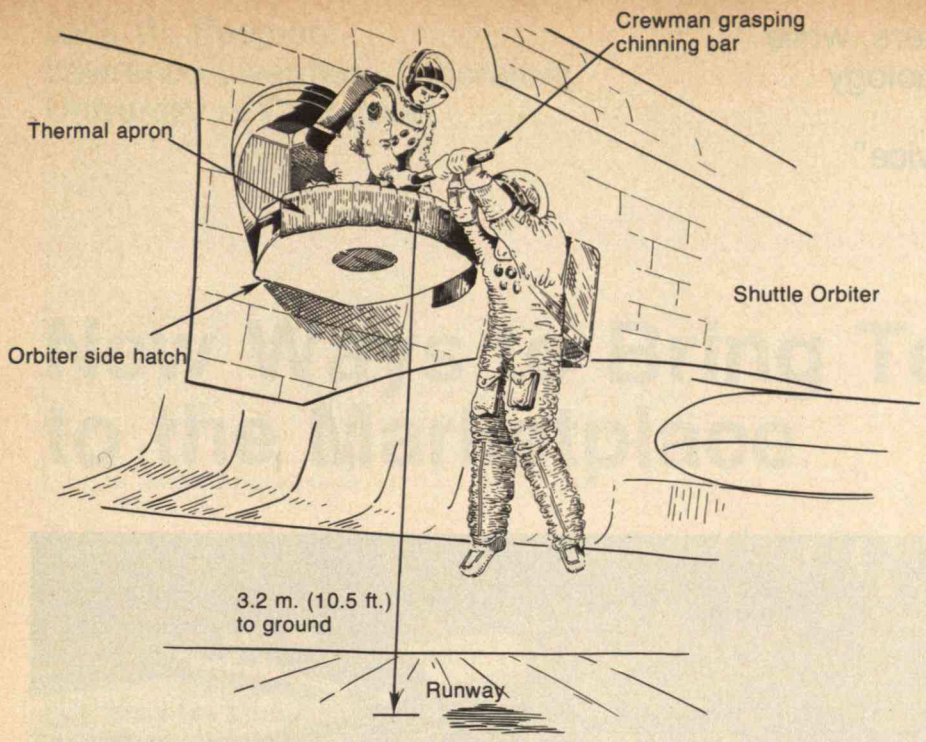
bloodstream to prevent dysbarism ("bends") when going from the oxygen-nitrogen Orbiter environment to the lower spacesuit and rescue sphere (pure oxygen) operating pressures. Even after mission requirements are met there will always be a reserve of consumables for one extravehicular rescue operation of up to six hours, plus 30 minutes for airlock egress and ingress and another 30 minutes of contingency consumables.

Crewmembers will be able to leave an Orbiter cabin through the airlock or side hatch. The side hatch exit involves depressurizing the entire cabin, and it would be used only if cargo bay doors were inoperative, preventing egress through the airlock. The airlock (*see above*) is the preferred route, because its use would allow escape of only a small portion of the cabin atmosphere which would be quickly resupplied from Orbiter consumables.

The mechanical manipulator can be carried on all missions and consists of a 50-foot-long boom with a wrist assembly and grasping mechanism *(see page 16)*. Its operator, inside the Orbiter cabin, will guide the manipulator by using information from television cameras in the payload bay and on the boom or by watching the manipulator's progress through viewing windows. The area of the manipulator's operations will be illuminated by lights on the Orbiter and on the boom. The manipulator arm can be used for rescue in one of several ways:

— By grasping a crewmember to be rescued and manipulating him to the airlock;
— By attaching itself to the disabled vehicle to provide a transfer path;
— By deploying tether lines to the disabled craft for a crew-assisted rescue.

If the disabled craft is tumbling and a manipulator or docking module cannot be attached to it, the crew to be rescued could "bail out" and be retrieved by astronauts using Manned Maneuvering Units. This is a "worst case" rescue condition but could be an only choice.



Within 60 seconds after a landing, the crew can perform an emergency exit by using the Orbiter side hatch and its associated gear. Pyrotechnic blow-out panels atop the Orbiter cabin provide a backup egress route, for instance, in case of ocean ditching. (Drawing: Robert Ullrich)

A Safe Path to Earth

During its non-powered reentry and landing operations, the Orbiter has a wide maneuvering latitude during which radio landing signals can be acquired. From an altitude of 400,000 feet down to 50,000 feet, the cross-range latitude is about 1,000 miles. Although landings will be manual, the Orbiter's automated landing system can maintain the proper glide slope and the correct direction for runway landing, perform the final touchdown maneuver, and maintain the Orbiter's heading on the runway until the vehicle comes to a full stop. The Orbiter can land on a 10,000-foot-long, 150-foot-wide runway equipped with standard "UHF Tactical Air Navigation Aid" landing aids. The prime landing sites (also the launch sites) will be at the Kennedy Space Center in Florida and Vandenburg Air Force Base in California. Both these sites feature runways 15,000 feet long and 300 feet wide with completely redundant microwave landing systems at each end. High-intensity approach and runway lighting systems are available for instrument and night landings under inclement weather conditions. A secondary landing site at Edwards Air Force Base, California, provides essentially the same facilities as the primary landing sites, and two additional sites with 10,000-foot runways are also recognized as contingency landing sites for the Orbiter — Hickman Air Force Base, Hawaii, and Andersen Air Force Base, Guam. If reentry is abnormal and the Orbiter is unable to reach one of these landing sites, an emergency landing (for instance, on Utah's salt flats) or water ditching will be necessary. Landing success depends, of course, on pilot dead-stick landing skill, since no power or go-around capability is available.

Once an Orbiter has landed, the vehicle allows the crew to exit quickly without aid from ground personnel. To exit, a crewmember will open the side hatch, as shown above, deploy a thermal apron for protection from high outer-surface temperatures, and lower himself to the ground via a chinning bar attached to the hatch. In emergency situations, crewmembers will also be able to leave the flight deck through a window at the top of the Orbiter and use tethers to descend to ground level.

Water ditching studies conducted by N.A.S.A. using a 1/20-scale Orbiter mockup to determine impact loads and flotation characteristics show that the Orbiter will remain afloat for a "reasonable" length of time depending upon the vehicle's structural integrity after landing. A survival kit providing emergency communication equipment and survival provisions for a minimum of 24 hours — a total of 42 pounds — will be available.

We must assume that space is a dangerous, little-known realm, so the techniques and equipment described in this article by no means represent the end of safety research on the Shuttle. As operations warrant, there will no doubt be new techniques to protect that most precious payload in space — the human being.

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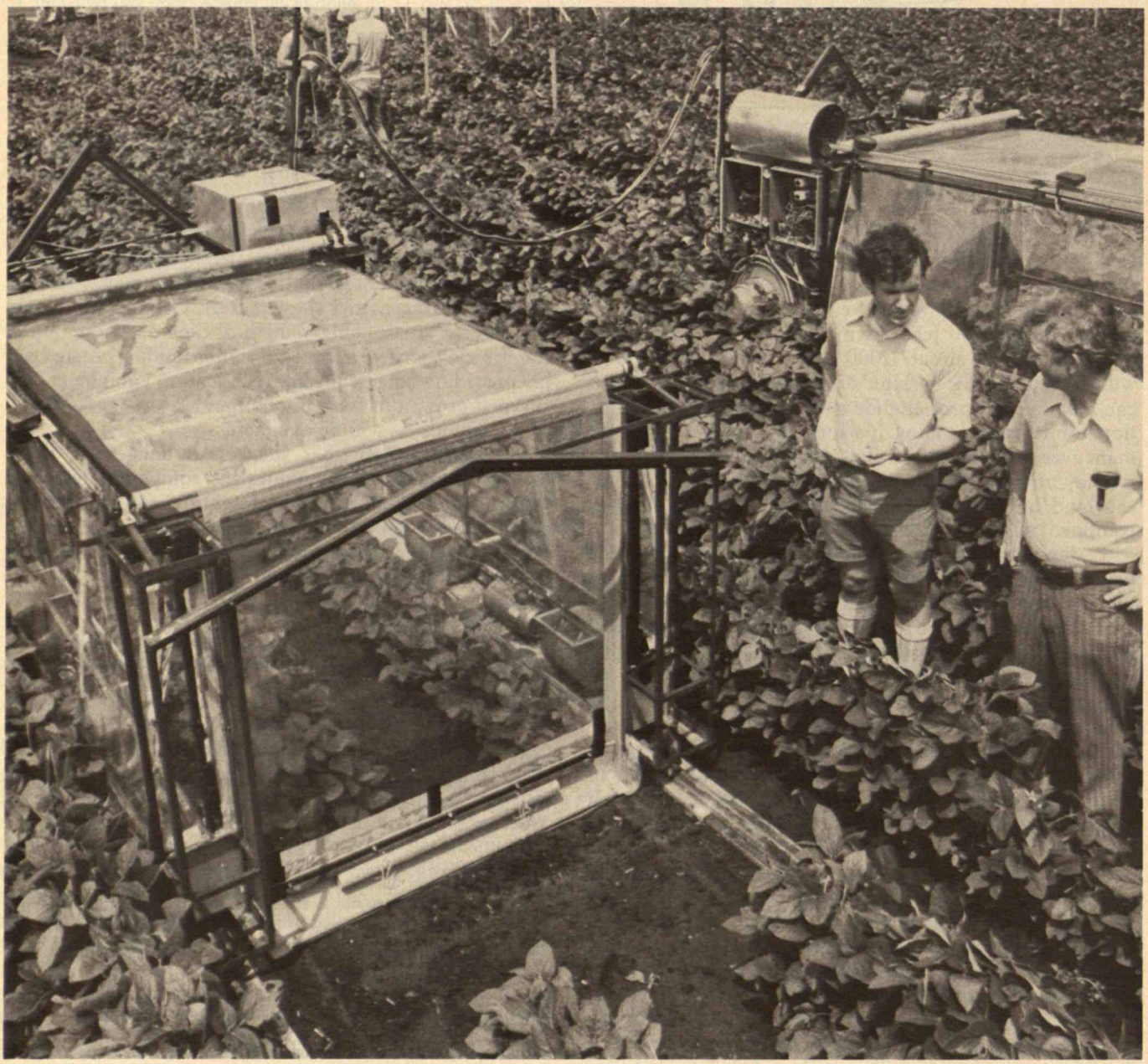
Nelson E. Brown has been associated with the U.S. space program as a contractor to N.A.S.A. since 1963. He has directed research and applications programs relative to manned extravehicular activities, crew flight safety and human factors design in spacecraft systems. He is currently specializing in Shuttle payload planning and operations, and has presented the results of his research at various national and international space symposia. He received a B.S. degree in Mechanical Engineering from the University of Tennessee in 1960 and pursued advanced studies in human factors and aerospace engineering at the University of Alabama.

Our national productivity falters, while potentially commercial technology gathers dust on the shelf. A "Technology Extension Service" could turn things around.



American agriculture has become the most efficient and productive food production system in the world, thanks in great part to the effective technology delivery system of the nation's Cooperative Extension Service. A similar system for industry could restore our lagging industrial productivity. Shown here are U.S. Department of Agriculture soil scientists checking a mobile apparatus to measure the basic metabolic mechanisms of plants. (Photos courtesy U.S.D.A.)

Jack W. Pearson
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University of California

New Ways to Bring Technology to the Marketplace

To begin, we must accept that the United States exists in a world of scarcity — that our resources are not and will not be adequate to do all we would like to do. So it will become more and more important to sharpen our criteria for efficient management of the nation's natural, human and technological resources. As I hope to show in this article, there has been far too little collaboration among government, industry and academia in commercializing our store of technology.

Our national productivity depends on a combination of labor, capital, and technology, and many economists contend that, of the three, the growth of technology has contributed the most to our past economic growth. Labor and capital are largely substitutable; that is, a rise in labor costs stimulates substitution of more capital-intensive production facilities. Technology is an independent input into the economy. It can offer productivity growth without being affected by either the labor or capital markets. Technology is also special in that it can be given away without losing it; that is, it can be transferred without the donor suffering any loss in the technology. This unique characteristic, plus the almost instant mobility of knowledge in today's world, give technology a potential for an enormous impact on productivity over a short time, in contrast to the relatively slow growth potential of labor and capital.

Importantly, while labor and capital affect productivity directly, technology cannot be applied directly. It must be commercialized, adapted, or processed into some useful product or productive capability. And it is here, I contend, that we are lagging. I should mention that my use of the term "productivity growth" includes, not only materialistic growth, but "growth" in quality-of-life. This definition takes into account the legitimate concerns over the pollution and overcrowding that would result from a purely materialistic definition of the term.

Plenty of Technology to Market

If I am to contend that we are weak in our technology commercialization programs, I must first deal with the question of whether there would be enough technology to commercialize in the first place. Many observers, including myself, are convinced that we do, indeed, have a plentitude of technology. For instance, a comparison of receipts from technology royalties and licenses for 1960, 1965, and 1970, as shown on page 30, reveals that the U.S. provides to other countries far more technology than it receives. And the graph does not show all the technology exported in the form of products distributed by the pervasive spread of American multinational companies. In addition, federal programs to give incentives for greater private-sector technology innovation have revealed difficulties, not in the availability of advanced technology, but rather in technology marketing and distributing mechanisms.

To argue a national underinvestment in technology commercialization it is also necessary to demonstrate that resources now applied elsewhere can be more profitably used to enhance the technology factor of our national productivity. We must consider the advantages of a tradeoff because the real cost of any resource allocation is the opportunity lost somewhere else. We cannot, however, obtain direct empirical evidence that we would be wiser to invest more in technology commercialization. There is no way to set up a controlled experiment demonstrating the best division of technology resource allocation within our social structure. However, there is circumstantial evidence that we would profit from more investment in technology commercialization. This evidence, as we'll see, is obtainable from studies of how we have applied technology in the United States and from comparisons with practices in other countries that show productivity growth similar to our own. Especially interesting is the evidence, which we will discuss later, that the United States is falling behind the other industrialized countries in productivity growth.

When the Marketplace Fails

Market forces will always provide a large measure of technology commercialization in a competitive market where an entrepreneur's benefits appear attractive enough to offset his risk. The impediments and disincentives to market allocation of technology resources are government-imposed in the form of regulatory and tax policy. Much technology development and application is not supported by market allocation, however, because the benefits are externalized, as social or public goods, to the extent that the return to an individual investor does not justify his investment.

For instance, the private sector is reluctant to support research and development in precision manufacture of machine parts, because its benefits are difficult to internalize, whether through patent protection or market capture. It is significant that there is an emphasis on precision technology in the state-subsidized manufacturing research centers common in all industrialized countries except the United States.

Such a poor showing in precision manufacture has

definitely cost U.S. industry a competitive edge internationally. For instance, a few years ago the U.S.S.R. issued bids for proposals to all industrial countries for the construction of turnkey truck manufacturing plants at their huge Kama River complex. U.S. tool and die consortiums that formed to respond to these bids for proposals declined to bid high-precision production plants, such as one producing diesel fuel-injection assemblies. The U.S. consortiums did not have at hand the precision technology needed to assure the required quality control. So, the U.S.S.R. production plant contracts for precision products typically went to Sweden, Germany and Japan.

Automated manufacturing represents another area of lagging technology commercialization with enormous economic potential. Here, too, the combination of risks and externalized benefits inhibit private investment. The forerunner of automated manufacturing, the numerical control (NC) machine tool, was developed in the U.S. during the early 1950s as a result of the growing need for more accurate fabrication control of complex wing shapes needed for jet-powered aircraft. The Air Force funded efforts at M.I.T. which, with industry, developed the first NC machine tool. When the growing use of NC tools created a bottleneck in the NC programming, the same government-university-industry team developed the architecture for a generalized NC language called automatic programmed tool (APT). Under sponsorship of the Aircraft Industries Association, the basic APT program was completed by 1960 and has since undergone further refinement at the Armour Research Foundation of the Illinois Institute of Technology.

As a result of this cooperative effort, the U.S. became a world leader in the hardware and software of this important new manufacturing technology. At that point, the development team disassociated, and since then the U.S. has lost leadership in the development of automated manufacturing to Japan, Norway, Germany, France, and Russia, with Japan coming closest to having the first fully automated factory. The automated manufacturing research and development efforts in these other countries are based on a similar collaborative arrangement among government, academia, and industry.

Evidence of Underinvestment

I realize that I have not automatically established the case for national underinvestment in commercializing technology merely by showing that the market focuses on internal benefits of technology commercialization and largely neglects external benefits. However, illustrating this neglect shows where the possibility of underinvestment lies. More important to my charge is that the fraction of GNP devoted to research and development since 1967 has declined, and that government-supported civilian research and development neglects development, especially in comparison to military and space work. In government-sponsored space and defense work, basic research comprises 9.7 per cent, and development 73 per cent. But in government-sponsored civilian-related work, research comprises 27 per cent, and development only 31 per cent.

Costs of development or applied research and development are always much larger than those of basic research. So, the fact that development occupies such a small portion of civilian research and development suggests at least an internal imbalance in how funds are allocated to technology utilization for public goods.

It should also be noted that, of all industrial countries, the U.S. government, by far, spends the most on research and development. But this investment is heavily concentrated in space, defense, and nuclear energy, with relative neglect of civilian industry research and development, in contrast to other industrial countries where civilian research and development is favored (*see page 31*).

An Unfavorable Comparison With Other Countries

Comparisons of U.S. technology utilization with that of other countries support the argument that our technology commercialization is lagging.

Over the last ten years four European nations, Switzerland, Sweden, Norway and Denmark, have risen to lead the United States in per capita income, with Germany close on our heels and Japan due to pass us within the decade. Our national productivity growth rate is continuing to decline. Part of the greater per capita income in the Scandinavian countries results from a larger per cent of population employed, but much of the ascendance of other countries is due to a more favorable productivity growth rate (*see page 32*).

During 1974, U.S. productivity growth in manufacturing continued the lagging performance revealed by the longer-term averages of 1966-1973 shown on page 32. Estimates for the first half of 1974 indicate that productivity in major industrial countries abroad, except in the United Kingdom, rose more than in the United States. From the first half of 1973 to the first half of 1974, output per man hour rose about 1 per cent in the United States while rising over 9 per cent in Japan, 6 per cent in France, 4 per cent in Germany, and 2 per cent in Canada.

A key element in the nation's cooperative extension service is the local extension agent who links the university agricultural research center and the farmer. A similar personal feedback mechanism from industry to academia would be needed for a "Technology Extension Service."

Thus, there are reasons to look for economic imbalances in the United States that work to prevent a competitive productivity growth rate.

Technology the Best Hope

Of labor, capital and technology, the technology sector of our economy clearly offers the most hope for future productivity gains. Over the last half-century, labor productivity growth in the United States has resulted primarily from the entry of surplus farm workers and in more recent years, from the entry of women. However, this source of growth has natural limitations for the future, especially considering the declining birth rate. Capital formation is limited by profit prospects and interest-rate controls on savings. Thus, capital growth is increasingly pinched by the decline in corporate profits and the lowest private savings rate of all industrial countries.

In addition, inflation acts to prevent capital formation. It chips away at real savings available for investment and overstates business profits. This eroding of private capital formation is magnified by the progressive tax system that — if inflation continues without tax rate adjustments — will eventually place everyone including the lowest wage earner in the highest tax bracket. Inflation has been the most politically realizable source of additional federal revenue. It will be tempting for government to stand by and let this method of increasing revenues continue. Because much of federal revenue is devoted to the distribution of revenues for immediate consumption, inflation acts as an illicit tax that stimulates present consumption at the expense of capital formation.

For every dollar of return on capital investment in the U.S., 75 cents goes for labor costs. In spite of this division of return on capital favoring labor, labor political policy emphasizes income distribution — a policy of trying to divide the pie more equally — even though clearly, labor gains most from policies that increase the size of the pie through increased capital investment.

These limitations on labor and capital leave the technology factor, which has also been declining, as the best hope for increasing the U.S. growth rate. In recent decades the traditional concept of productivity derived from relatively static factors of land, labor and capital has given way to the more dynamic labor, capital and technology concept. But the technology factor has not had an easy acceptance within the economic community. The struggle to categorize productivity factor inputs that, to me, appear as technology, is evident in contemporary economic literature. If we define technology as all mechanisms and procedures used to implement policy, then detailed calculations of economic data show that technology is responsible for about 70 per cent of our economic growth from 1930 to 1972. Moreover, our overall growth lagged behind other industrial countries during the entire post-World War II period.

Why Other Countries Lead

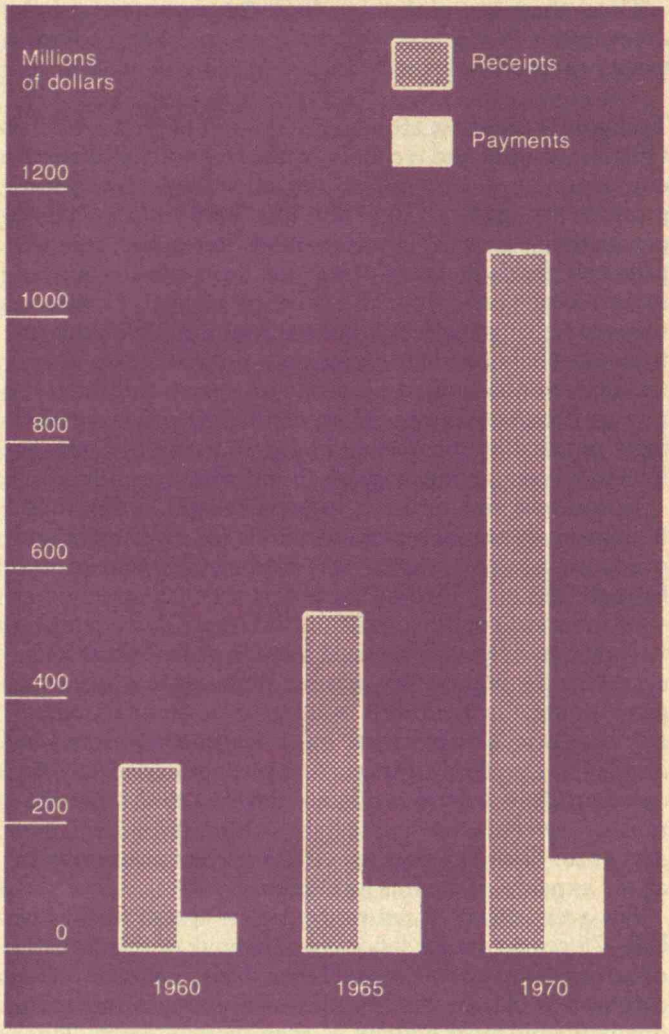
Let us assume that our poor showing in productivity growth rate comparisons with other industrial countries is valid evidence that there are better ways to allocate resources to technology commercialization. Then we should ask what characteristics of the other industrial countries have allowed them to catch up to and in some cases surpass the United States in per capita income. I believe that there is ample evidence that modern technology assiduously applied to the civilian industries deserves a large share of the credit for their greater growth rate. True, part of their record is surely due to the process of catching up with the long-standing United States technology lead. But much of their growth rates appears to be inherent, with no indication of recent diminishing returns in the trend lines that would be expected if their process were primarily one of catching up.

The circumstances are similar to those of Great Britain and Germany during the period 1850 until World War I. During this period Great Britain lost productivity leadership to Germany as a result of Germany's more rapid adaption and adoption of industrial technology, even though a good part of the advances in technology of that period were of British origin. To apply this theme to the subject at hand, one can speculate that failure of the U. S. to create and exercise an effective industrial technology delivery system, both on an absolute scale and relative to that of Japan and other industrial countries, is a significant factor in our slowing productivity growth rate.

The countries that seem most favored in their productivity growth rate have all somehow, within their social structure, found a way to achieve a close working harmony among the institutional elements important to technology development — government, academia, and industry. Japan, consistently with the highest growth rate, is monolithic in this respect. In contrast, the U.S. and Great Britain both suffer an almost adversary relationship among these elements.

In several industrial countries, political difficulties tend to obscure and, to a large extent, negate the benefits of close institutional collaboration. Even so, the presence of these benefits is a principal finding of a recent study by

The United States provides to other countries far more technology than it receives, as shown by the measure of royalties and license fees received from and paid to other countries for 1960, 1965 and 1970. Thus, we have plenty of technology to commercialize, if we can improve our technology commercialization systems.



the General Accounting Office (G.A.O.) of manufacturing productivity in other industrial countries. The study showed an average capital investment in manufacturing industries of $600 per worker in other industrial countries vs. $200 per worker in the United States.

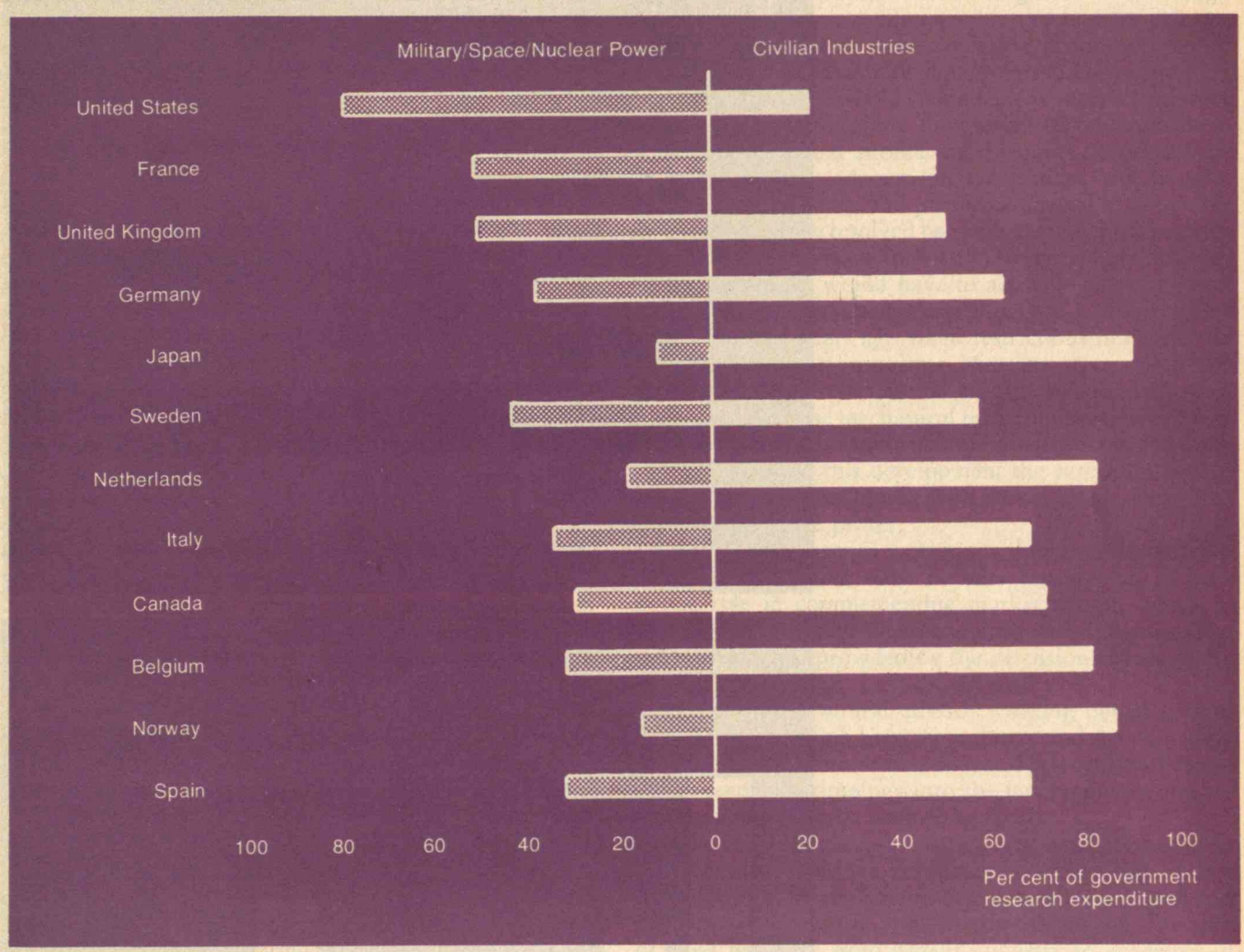
The study also revealed that 97 per cent of U.S. factories employ less than 500 people, meaning that they would particularly benefit from a service to help them implement new technology; larger companies have such services in-house. However, the study found that these companies were not nearly so well coupled to universities and other sources of technology commercialization aid as were small companies in other countries.

G.A.O. officials also pointed out that the European education system contributed to rapid technology commercialization. European higher education is different from ours in that anyone who wants a master's degree must have an industry sponsor, who may or may not finance the effort. This forces bachelor-level graduates to make their mark in industry before they can add to their formal education. The doctoral candidate must also have government or industry sponsorship and will usually have six years to solve the problem used to obtain sponsorship. Also, professors normally hold their posts for four years, then must be accepted by industry or government. This turnover in universities and the focus on applied technology to obtain higher degrees forces education relevancy and technology innovation. It results in a rotation of personnel among government, industry, and academia that contributes to a collaboration of all elements toward greater productivity.

The G.A.O. study also mentioned the widespread European "productivity centers" as important factors in technology commercialization. These centers, founded under the Marshall Plan after World War II, are governed by a board consisting of representatives from government, industry and academia. When approached by a private company with a new product, they perform productivity analyses on the new product, cost analyses, capital cost projections, and other manufacturing studies. Besides the value of this information in itself, the productivity center's analysis carries a great deal of weight with bankers, who are more ready to lend the manufacturer needed capital when he is backed up by the center's independent analysis.

Even if foreign countries' social structures are central to their greater growth rates, we cannot reasonably suppose that a social structure peculiar to another country can be imported to the United States to implement a more fruitful collaboration of institutions. It is, however, reasonable to ask whether there is an American example of close working harmony among government, academia, and industry in achieving a national goal where the primary benefit is in the form of public goods, and if so, whether the collaboration has been effective. Examples of benefits that come to mind are the machine tool technology mentioned earlier and the development of atomic energy, which resulted from the fruitful collaboration of government, industry and academia. But these, it may be argued, represent single-mission efforts born within a national crisis environment.

The U. S. government concentrates its research and development spending on defense, space and nuclear power, while foreign countries favor civilian industry. (1971 data from O.E.C.D.)



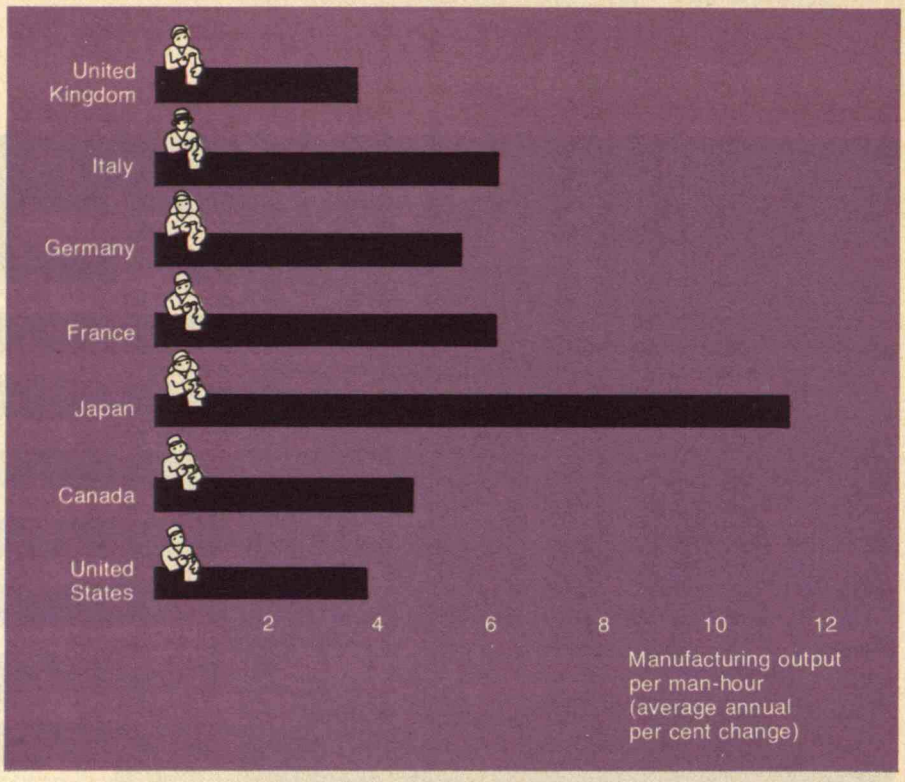
The Farmer's Ally

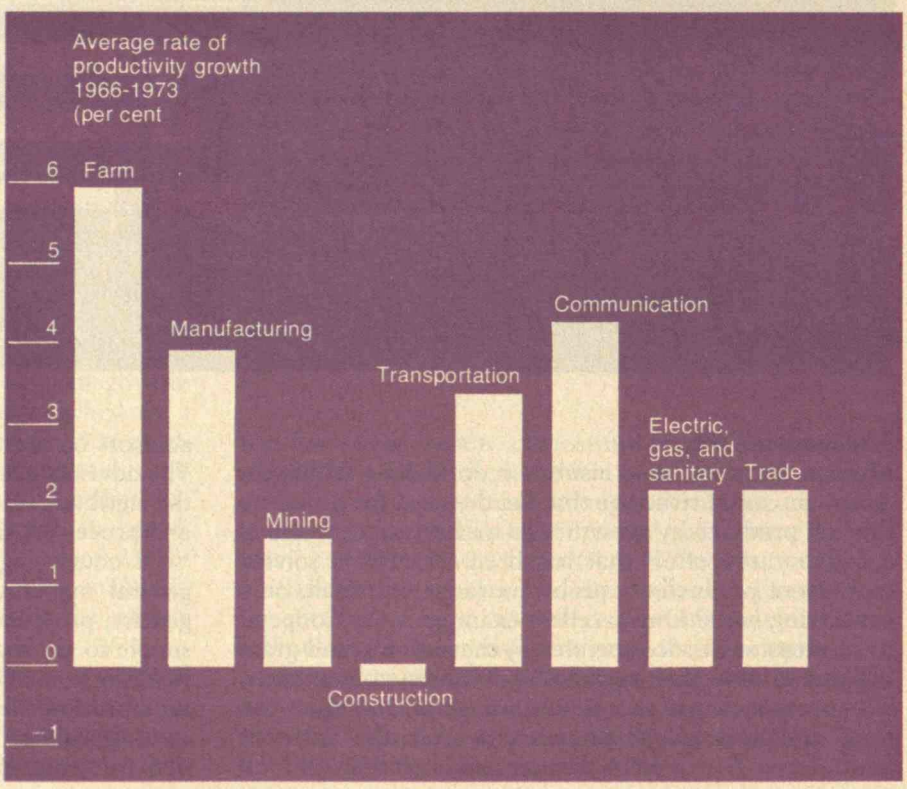
More to the point, what institution do we have within the American social structure that fits the need for broad industrial productivity growth? Do we have an example of a collaborative effort that has been effective in solving millions of productivity problems, large and small, on a continuing basis? One excellent example is the Cooperative Extension Service operated by the nation's land-grant colleges to serve their regional agribusiness communities. This program began over 100 years ago at land-grant colleges and took on its present characteristics with the Smith-Lever Act of 1914 that created a network of local advisors or county agents, as they are sometimes called. The advisors are skilled agricultural experts who go into the agribusiness community and work with producers and processors in implementing the latest technology.

Of course, agriculture is significantly different from general manufacturing in terms of user group homogeneity, proprietary jealousies and capital needs. It is too simple to say that the same approach that works for agriculture could be applied to industry in general without modification. Also, it is far from clear whether the American agriculture extension model, the European productivity center model, or, perhaps some other arrange-

Top: Productivity rates from 1966 to 1973 grew faster in almost all the other developed countries than in the U.S. Our lagging productivity growth rates could be remedied by better technology commercialization systems. (Data: Bureau of Labor Statistics)

Bottom: Farm productivity growth outpaced all other sectors in the U.S. economy, despite a decline in man-hours required. This remarkable achievement was due in large part to the extension programs of the land-grant colleges. A "technology extension program" might work as great a change in U.S. industry. (Data: Bureau of Labor Statistics)





ment, would serve as the best technology delivery system complementing market allocation within our social structure. Even so, it is worthwhile to examine the fundamental operating characteristics of our university-directed agriculture cooperative extension services.

For one thing, it is successful. Much of the miracle of American agricultural production is attributed to the extension programs of the land-grant colleges. And, because they are essentially voluntary programs, they do not violate American concepts of free economic choice. Of every dollar spent on agricultural research in this country, 50 cents is spent on its delivery to those who can use it. In other areas of scholarly research, the average expenditure on delivery of new knowledge is about 1 per cent of expenditures on the research itself.

As you can see on the facing page, agriculture has the best growth rate of all the major economic sectors in the United States, and this is in the face of a steady decline in labor input. For example, in 1966 farm labor required 6.8 per cent of total U.S. man-hours, while in 1973 it required only 5.2 per cent.

The Agricultural Triad

In the nation's agricultural cooperative program, the government identifies goals and supplies the funds needed to produce the public goods. The university extension controls research and development, and supplies the trained manpower needed to service industry and maintain its own research and development and training function. Industry implements new technology within its productive process by incorporating technology directly from the extension service and by using the contributions of university-trained manpower.

The university's critical role is to provide a commercially neutral, high-credibility management to allocate resources for public goods technology development and commercialization. The agricultural research and development budget, within academia and at the experiment stations, aims at addressing the high-priority problems of local agribusiness, not at providing interesting research projects for professors.

The university sometimes acts as a buffer between government bureaucracy and industry, heading off government actions that would be counterproductive within the local area. A large university working through the governor's office, the state's congressional delegation or through community leadership, will usually have more political clout to protect local interests than will the principals of some harassed enterprise. Thus, it provides the micro-economic viewpoint within the context of a national program.

The university is also able to manage funds from multiple sources. The California Extension Service, for instance, obtains approximately 50 per cent of its public funds from the state, 25 per cent from the federal government, and 25 per cent from local government. In addition, industry voluntarily contributes a percentage of identified benefits in the form of donations to the Extension Service.

The university also provides an important continuity of purpose and direction, and thus supports the long-term viewpoint within a political and economic environment that rewards short-term gains.

In this university-government-industry triumvirate, industry's important role is to implement change. Rapid adaptation to changing needs is something the business and corporate body does well and that neither governments nor universities can do. A modern business enterprise is the political entity best able to adapt to change and make the changes immediately part of our economy and culture through the mechanism of the open market. The system of rewards and penalties inherent in a competitive market environment ensures rapid response to the testing of efforts to exploit technology.

What Technology to Market?

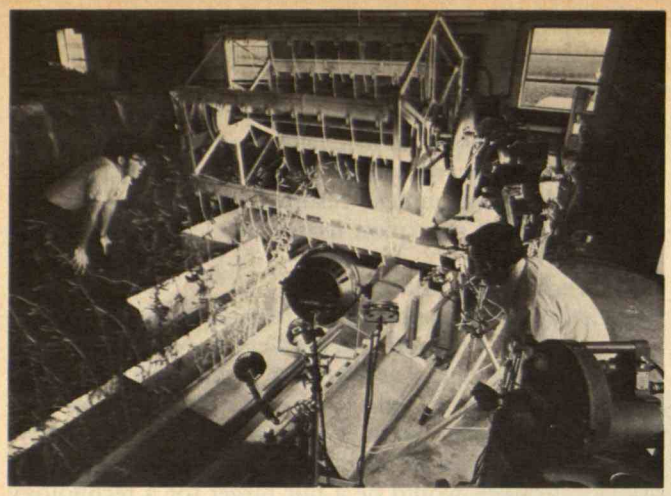
If we accept the Cooperative Extension Service model of how to give business incentives to commercialize technology, we must ask how a technology extension service would decide where to apply its resources and where to allow the market to function independently. Such decisions would be mainly pragmatic. Any high-priority problem would be a fair target for a technology extension service to address, with the highest priority given those problems whose solution promises a broad industry-wide productivity improvement. The technology extension service would complement normal market allocations and still allow the market to function freely where the potential profits are adequate to attract investment. Market adjustment, we assume, will be adequate for most needs, and problems amenable to market adjustment will be resolved before becoming high priority problems for extension address. However, many times an extension service would have to act as a quick-reaction scheme when the market reacts slowly to a problem. For instance, a few years ago when restrictions in California were legislated on importing Mexican stoop labor for field crops, there was created an almost overnight need for a low-labor-use mechanical tomato picker, which was developed through a cooperative industry/extension service effort. To aid this development the extension service very rapidly bred a tomato with a skin tough enough to be handled by the picker.

Such a public agency working within a predominantly market environment must be very sensitive to its economic role in complementing market action, which in turn, requires a very close coupling with industry. The close coupling is provided by the extension offices of the local advisor.

The local agricultural advisor working out of county offices is the key link between industry and the university in the cooperative extension service. He works both way, spoon-feeding technology into the farm industry and relaying industry needs back to academia.

In contrast, general industry feeds back its needs to academia by hiring the graduates of universities. Such a feedback is far too general to help determine research and development direction and structure curricula. The lack of close feedback from general industry to academia in the United States may explain why there is almost no manufacturing engineering taught in American universities. In contrast, manufacturing engineering (not to be confused with industrial engineering) is emphasized in other industrial countries. For example, France introduces the concept of productivity at the junior high school level and discusses such advanced technology as Computer Aided Design/Computer Aided Manufacturing in the high schools.

My own studies of the effectiveness of technical information systems confirm the value of the active consultant in technology transfer. Large information systems that lack the coupling service of a professional worker be-



Applied research by the Department of Agriculture has been remarkably helpful to the farmer, because the close relationship between the industry and government assures that high-priority problems are quickly identified. Here, government researchers use a high-speed motion picture camera to record the feeding of soybean stalks into a harvester reel. The film will allow the engineers to determine reasons for harvester losses.

tween the data bank and the user become almost impotent in transferring technology. In contrast, the successful information systems focus on a special class of problems and provide person-to-person working arrangements within the chosen field. This process is well developed within the Extension Service. A typical career path for a professional in the Extension Service is to spend his academic years learning his field and his research years developing technology within an experiment station; then, somewhere between the ages of 40 and 55, when he begins to be more interested in applications of his learning, he is groomed as a local advisor to be stationed out in the community.

The "Technology Extension Agent"

A local advisor to general industry would be likely to have a more difficult job than his counterpart in agriculture because of the greater diversity of technical and business challenges. The problems of coping with such a diversity have been encountered by the few university extension services that address general industry problems, such as the Engineering Experiment Station of Georgia's Institute of Technology and the Institute of Public Service of the University of Tennessee. Experience shows that the local advisor in a general industry service is still a key element, but he will function relatively more as a router of problems and require a broader multidisciplinary backup.

A few agricultural extension services have begun to expand their role to encompass general industry, such as the Missouri Cooperative Extension Service. Missouri farmers welcomed the broader business and industry competence of the well-established agricultural service to serve general industry, because the typical extension client has changed from the family farmer to the corporate producer and processor with broader industrial problems of finance, planning, marketing, and community relations along with a more complex technology.

Interestingly, general manufacturing, as well as agriculture, is included in the land grant college charter that is the legislative foundation of the state university's aid to agribusiness as specified in the Morrill Act of 1862. Only tradition has maintained the agricultural focus of the Extension Service. The predominantly agrarian economy of 1862 and the Hatch Act of 1887 that provided for experiment stations, plus the Smith-Lever Act of 1914 that established the extension service served to focus university technical aid effort in the beginning on agriculture.

Past Failures, Future Success

There have been many attempts, only marginally successful, by the federal government to enhance technology commercialization by establishing technical information systems. These efforts to make available shelf-technology from government research include the State Technical Services Act Programs begun in 1965. This system was designed to link universities with regional industry, but was denied further federal funding in 1969, allegedly for want of adequate results, although many states have continued the effort on their own. There are arrays of technical information centers funded by N.A.S.A., D.O.D. and the National Technical Information Service of the Department of Commerce. The Energy Research and Development Administration (E.R.D.A.) funds efforts by its principal research and development contractors to make E.R.D.A.-funded research and development information available for the asking. Efforts to publicize the technical information services and identify data bank contents vary widely from center to center.

Technical information data banks are needed and important but are less than ideally effective without an active user coupling mechanism. It seems significant that the N.A.S.A. technical information centers have evolved from passive centers that supplied on request whatever documents and reports resided in the data bank, to the kind of effort exemplified by the N.A.S.A.-funded New England Research Application Center which now has university affiliation and local advisors to help identify problems and to help potential users interpret pertinent information from the bank. Also, because federally-funded off-the-shelf technology is rarely suitable for commercialization as is, some adaptive engineering, as provided by experiment stations, is needed to bring this technology to the threshold of commercial attractiveness. Lack of an adaptive engineering capability is a handicap in obtaining full commercial utility of a technical information center.

Another technology delivery system in the U.S. is the case study kind exemplified by the Materials Processing Institute at Carnegie-Mellon University. This approach relies on finding real industrial problems for address by engineering students and teachers. The manufacturer supplies the problem and benefits from a case study of his problem. The case study approach has considerable merit, especially for business management problems. A major problem is that industrial problems do not usually fit into the neat time-mold of the academic semester or quarter. Also, academic compartmentalization makes it

difficult to provide a multidisciplinary approach to what are usually multidisciplinary industrial problems. As a technology delivery system, the case study approach contributes more to the educational process than to technology transfer.

Five "Musts" For A Technology Service

A Lawrence Livermore Laboratory study of technology commercialization services in the U.S. — including university affiliated extension services, state and regional economic development efforts, and the N.A.S.A. and D.O.D. technology transfer programs — shows that five interacting operating elements are important to success:

— *University affiliation,* which, in addition to the management services and the regional or micro-economic viewpoint discussed previously, provides a multidisciplinary resource bank and couples government and industry. The university also nourishes the service with a steady supply of trained personnel.

— *Experiment stations* where research and development are conducted in support of both industry and academic purposes. An important role of the experiment station is to do the applied research and development necessary to bring the knowledge acquired from basic research to the stage where industry feels confident in proceeding with commercialization efforts. The experiment station is also the melding arena where multidisciplinary task-oriented teams are formed from the discipline-oriented resources of the university.

— *Resident experts* who respond to local advisor requests with information from their own knowledge, contacts with others in their field, and access to today's large network of national and international technical information systems. They also do research and development within the experiment station in response to both specific and general industry needs.

— *Local advisors* who provide limited on-the-scene information, feed back problems and interest trends to the extension service management and follow up technology transfer efforts. They act as the marketing arm of the service in establishing identification and rapport between industry and the service.

— *A coordinated education and training program* to educate the technology recipient to the level that smooths the path for technology transfer. This is another reason why university affiliation is important. A common misconception is that the agricultural service has been successful because well-trained agriculturalists were working with the relatively untutored farmer who was, thus, receptive to their ideas. On the contrary, this was an earlier handicap that has all but disappeared in today's agribusiness environment, which typically includes university trained extension clients, many of whom hold the M.B.A. as well as degrees in agricultural science.

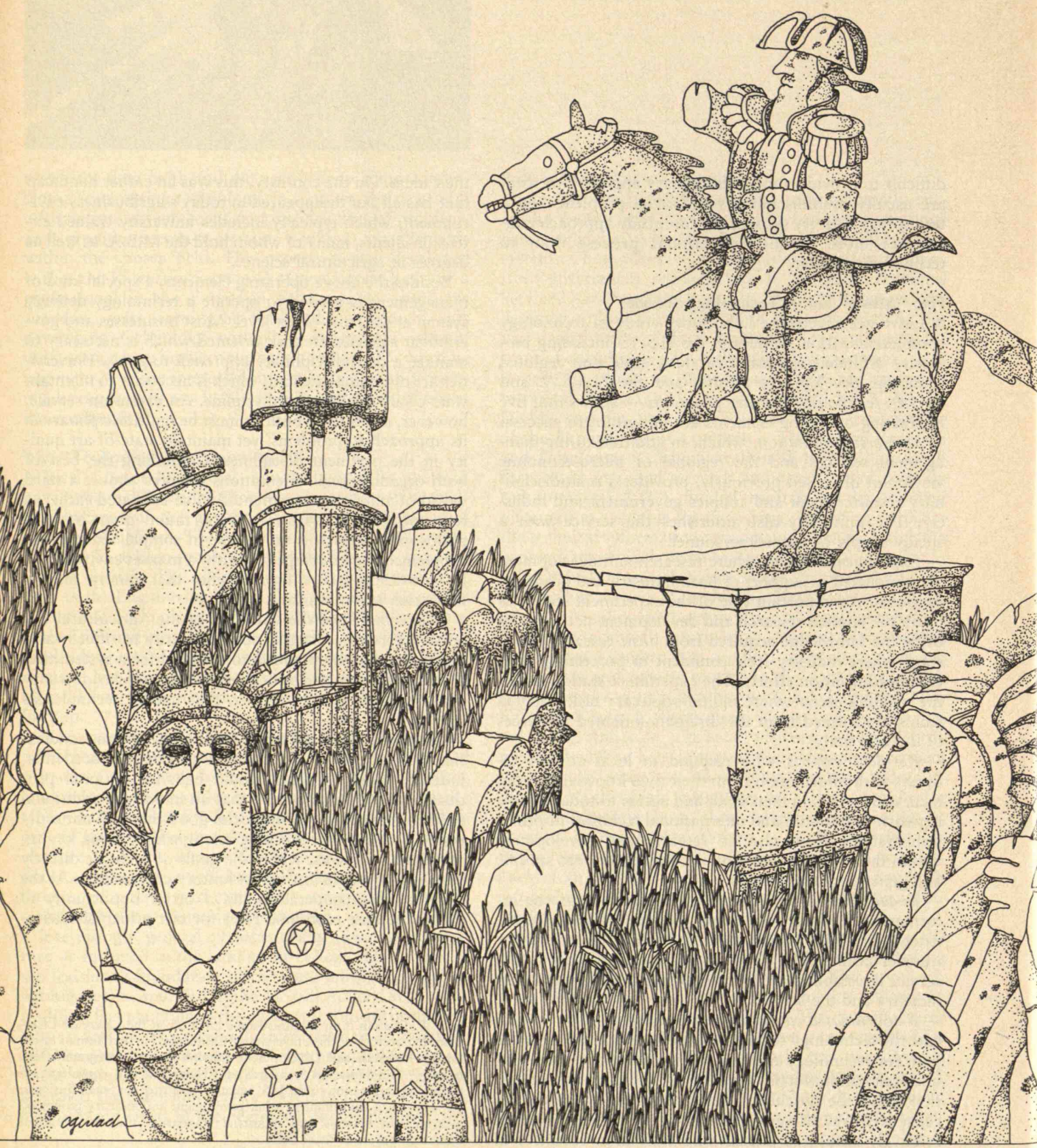
Besides the above operating elements, a special kind of management is needed to operate a technology delivery system at the state-of-art level. Most businesses and government agencies are task oriented which is necessary to manage a multidisciplinary approach to goals. Universities are discipline oriented, which is necessary to maintain state-of-art quality of a discipline. An extension service, however, needs to be both. It must be multidisciplinary in its approach to problems, yet maintain state-of-art quality in the pertinent disciplines. Combining the best of both organizational orientations requires almost a third world of matrix management. As I've indicated earlier, a technology extension service must also have a philosophic sensitivity to its role in complementing (not supplementing or competing with) a market environment by providing technology benefits that purely market allocation leaves wanting.

I have explained the workings of the Agricultural Extension Service at length, not necessarily to offer it as a model, but to call attention to the need for a system that is comprehensive and structured enough to provide a supply and demand approach so that needed technologies *will* be developed.

Certainly, more effective technology commercialization through a more collaborative government, academia, industry social structure could enhance national productivity. But I also believe that an important additional political benefit lies in the social good that will naturally result from a closer working relationship among key institutional elements, where the goals of each are directly seen as achievable through voluntary cooperation. At the heart of this cooperation lies a better opportunity to define the best economic roles for our principal institutions.

Jack W. Pearson is an Administrative Engineer at the Lawrence Livermore Laboratory of the University of California. He is chairman of the Energy Research and Development Administration's Integrated Contractors' Committee on Standards and Units and is a consultant on technology utilization to the U.S. Senate Committee for Small Business. He serves as a consultant to other government and industry groups on measurement systems and industrial standards, and has authored numerous papers in those fields.

They're consulting, pleading, trotting, temporizing, putting out fires, either avoiding or taking too much heat — and spending too much energy doing it.



Warren G. Bennis
President
University of Cincinnati

Where Have All the Leaders Gone?

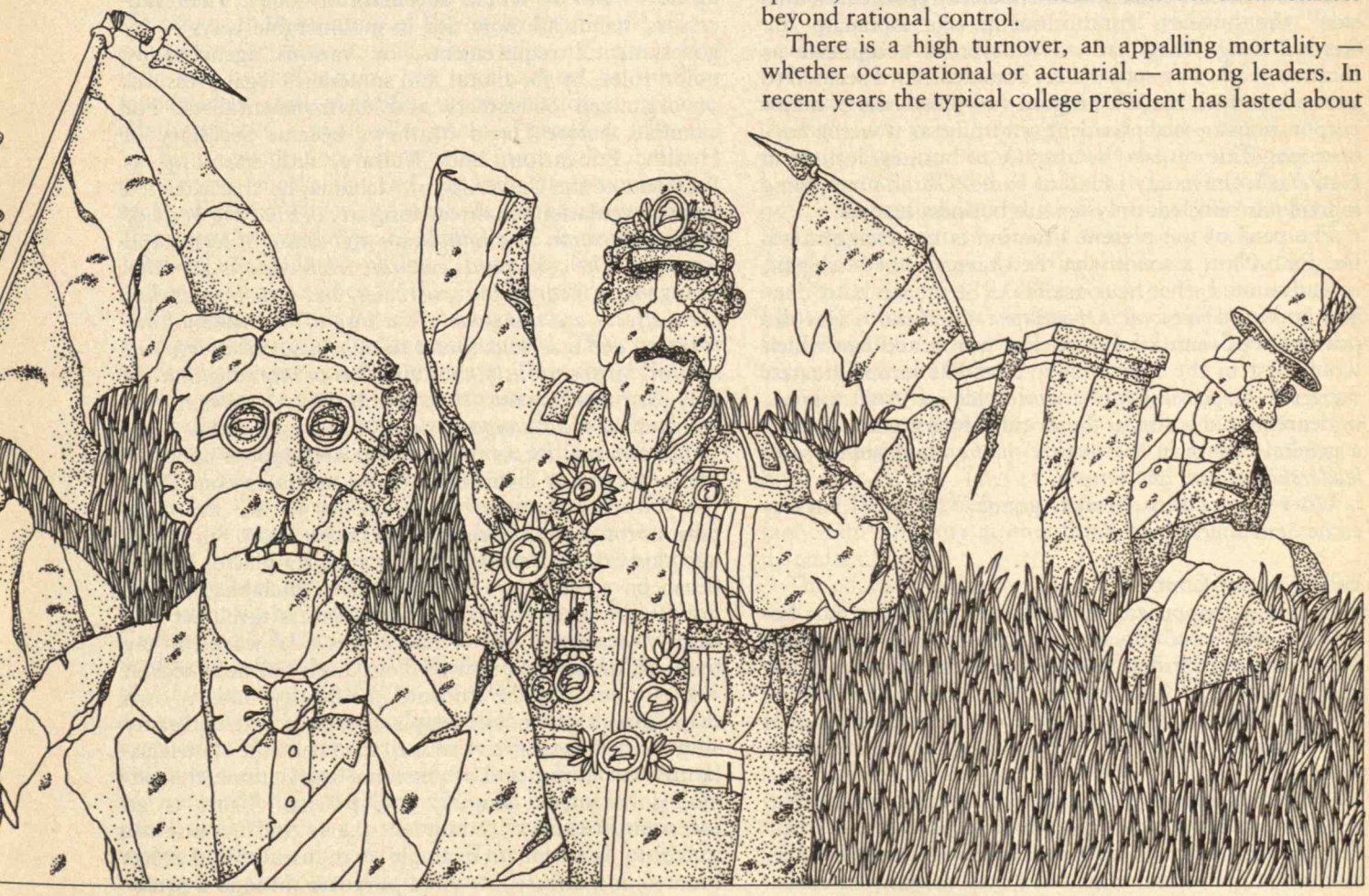
Where have all the leaders gone? They are, as a paraphrase of that haunting song reminds us, "long time passing."

All the leaders whom the young respect are dead. F. D. R., who could challenge a nation to rise above fear, is gone. Churchill, who could demand and get blood, sweat, and tears, is gone. Eisenhower, the most beloved leader since Washington, is gone. Schweitzer, who from the jungles of Lambarene could inspire mankind with a reverence for life, is gone. Einstein, who could give us that sense of unity in infinity, is gone. Gandhi, the Kennedys, Martin Luther King, all lie slain, as if to prove the mortal risk in telling us that we can be greater, better than we are.

The landscape is littered with fallen leaders. A President re-elected with the greatest plurality in history resigns in disgrace. The Vice President he twice chose as qualified to succeed him is driven from office as a common crook. Since 1973 the governments of all nine Common Market countries have changed hands — at least once. In the last year over a dozen major governments have fallen. Shaky coalitions exist in Finland, Portugal, Argentina, Belgium, Holland, and Israel. Minority governments rule precariously in Britain, Denmark, and Sweden. In Ethiopia, the King of Kings died captive in his palace.

The leaders who remain, the successors and the survivors — the struggling corporate chieftains, the university presidents, the city managers and mayors, the state governors — all are now seen as an "endangered species," because of the whirl of events and circumstances beyond rational control.

There is a high turnover, an appalling mortality — whether occupational or actuarial — among leaders. In recent years the typical college president has lasted about



Drawings by Cameron Gerlach

four years; in the decade of the 1950s, the average tenure was over eleven years. Men capable of leading institutions often refuse to accept such pressures, such risks. We see what James Reston of the *New York Times* calls "burnt out cases," the debris of leaders. We see Peter Principle leaders rising to their final levels of incompetence. It has been said that if a Martian were to demand, "Take me to your leader," Earthlings would not know where to take him. Administrative sclerosis around the world, in political office, in all administrative offices, breeds suspicion and distrust. A bumper sticker in Massachusetts summed it up: "Impeach Someone!"

In business the landscape is equally flat. The great leaders that come to mind — Ford, Edison, Rockefeller, Morgan, Schwab, Sloan, Kettering — are long gone. Nixon's business chums were either entrepreneurs "outside" the business Establishment, like Aplanalp the Aerosol King. They had no widespread acceptance as business leaders or spokesmen. President Ford seemed to get on best with the Washington vice presidents of major corporations (a vice president syndrome as it were). *Fortune* magazine reveals the absence of business leaders in New York University's Hall of Fame. Of the ninety-nine individuals selected, only ten are business leaders.

The peril of the present situation is not exaggerated. Dr. John Platt, a scientist at the University of Michigan, recently stated what he considers to be the ten basic dangers to world survival. Of greatest significance was the possibility of some kind of nuclear war or accident which would destroy the entire human race. The second greatest danger is the possibility of a worldwide epidemic, famine, or depression. He sees as the world's third greatest danger a general failure in *the quality of the management and leadership of our institutions.*

Where have all the leaders gone? Why have they become "endangered species?"

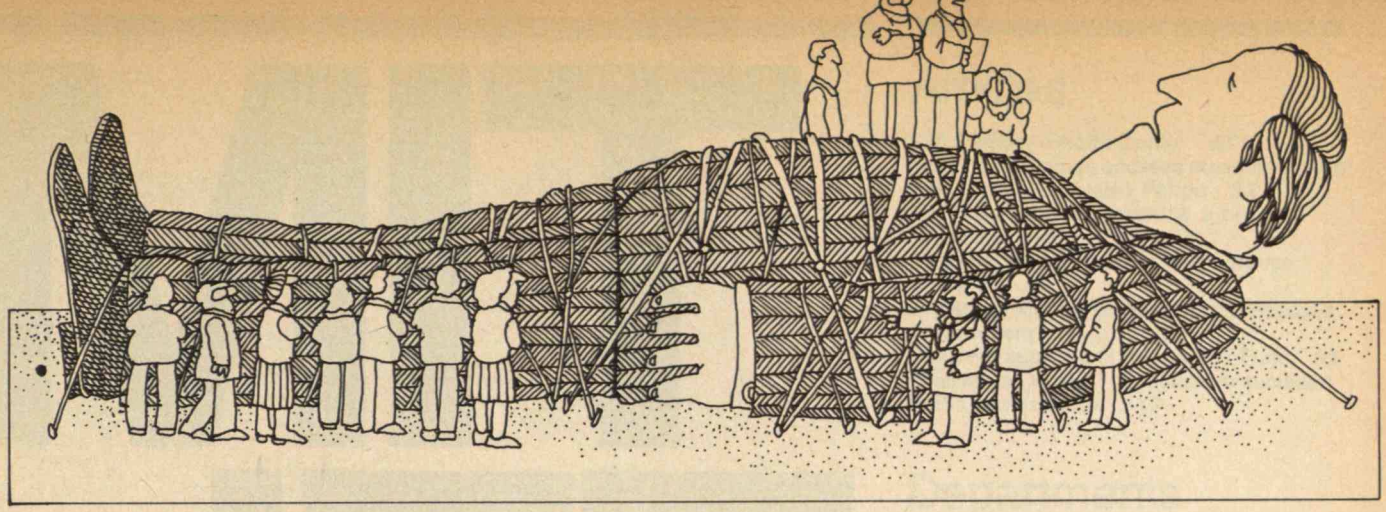
Falling out of Control

Something's happened, that's clear; something that bewilders. As I write this, for example, it can be noted that our technology brings together, at 600 m.p.h. speeds, people who left Los Angeles, San Francisco, Denver, Chicago, Atlanta, at lunch, only to have them all blown to smithereens by a bomb left in a baggage locker at an airport.

It's as if mankind, to paraphrase Teilhard de Chardin, is *falling suddenly out of control of its own destiny.* Perhaps only a new Homer or Herodotus would be able, later on, to show us its patterns and designs, its coherences and contours. We still lack that historical view. What we hear and discern now is not one voice or signal but a confusing jim-jangle of cords. All we know for sure is that we cannot wait a generation for the historian to tell us what happened; we must try to make sense out of the jumble of voices now. Indeed, the first test for any leader today is to discover just *what* he or she does confront; only then will it be possible to devise the best ways of making that reality — the multiple realities — potentially manageable.

The most serious threat to our institutions and the cause of our diminishing sense of able leadership is the steady erosion of institutional autonomy. Time was when the leader could decide — period. A Henry Ford, an Andrew Carnegie, a Nicholas Murray Butler could issue a ukase — and all would automatically obey. Their successors' hands are now tied in innumerable ways — by governmental requirements, by various agencies, by union rules, by the moral and sometimes legal pressures of organized consumers and environmentalists. For example, before David Mathews became Secretary of Health, Education, and Welfare, and speaking as President of the University of Alabama, he characterized federal regulations as threatening to . . . *bind the body of higher education in a Lilliputian nightmare of forms and formulas. The constraints emanate from various accrediting agencies, Federal bureaucracies, and state boards, but their effects are the same . . . a loss of institutional autonomy, and a serious threat to diversity, creativity, and reform. Most seriously, that injection of more regulations may even work against the accountability it seeks to foster, because it so dangerously diffuses responsibility.*

The external forces that impinge and impose upon the perimeter of our institutions — the incessant concatenation of often contrary requirements — are the basic reasons for the loss of their self-determination. Fifty years ago this external environment was fairly placid, like an ocean on a calm day, forecastable, predictable, regular, not terribly eventful. Now that ocean is turbulent and highly inter-dependent — and makes tidal waves. In my own institution right now the key people for me to reckon with are not only the students, the faculty, and my own management group, but people external to the university — the city manager, city council members, the state legislature, accrediting and professional associations, the federal government, alumni, and parents. There is an incessant, dissonant clamor out there. And because the university is a brilliant example of an institution that has blunted and diffused its main purposes through a prolif-



eration of dependence on "external patronage structures," its autonomy has declined to the point where our boundary system is like Swiss cheese. Because of these pressures, every leader must create a department of "external affairs," a secretary of state, as it were, to deal with external constituencies.

Accompanying all this is a new kind of populism, not the barn burners of the Grange days, not the "free silver" of Bryanism ("The crown of thorns"), but the fragmentation, the caucusization of constituencies. My own campus is typical; we have over 500 organized governance and pressure groups. We have a coalition of women's groups, a gay society, black organizations for both students and faculty, a veterans' group, a continuing education group for women, a handicapped group, a faculty council on Jewish affairs, a faculty union organized by the American Association of University Professors, an organization for those staff members who are neither faculty nor administrators, an organization of middle-management staff members, an association of women administrators, a small, elite group of graduate fellows.

This fragmentation, which exists more or less in all organizations, marks the end not only of community, a sense of shared values and symbols, but of consensus, an agreement reached despite differences. It was Lyndon Johnson's tragedy to plead, "Come let us reason together," at a time when all these groups scarcely wanted to *be* together, much less reason together.

These pressure groups are fragmented. They go their separate and often conflicting ways. They say: "No, we don't want to be part of the mainstream of America — we just want to be us," whether they're blacks, Chicanos, women, the third sex, or Menominee Indians seizing an empty Catholic monastery. They tell us that the old dream of "the melting pot," of assimilation does not work — or never was. They have never been "*beyond* the melting pot" (as Glazer and Moynihan wrote about it); they have been *behind* it.

So what we have now is a new form of politics — King Caucus, who has more heads than Cerberus, and contending Queens who cry, "Off with their heads!" as they play croquet with flamingos. It is *the politics of multiple advocacies* — vocal, demanding, often "out of sync" with each other. They represent people who are fed up with being ignored, neglected, excluded, denied, subordinated. No longer do they march on cities, on bureaus, or on organizations they view as sexist, racist, anti-Semitic, or whatever. Now, they file suit. The law has suddenly emerged as the court of first resort.

A Litigious Society: "Is the Wool Worth the Cry?"

And so, we have become a litigious society where individuals and groups — in spectacularly increasing numbers — bring suits to resolve issues which previously might have been settled privately. A hockey player, injured in his sport, bypasses the institutional procedures to bring formal suit. The club owners are outraged that one of "its own" would take the case "outside." College students, unhappy with what they are learning on campus, are turning to the courts as well. A lawsuit against the University of Bridgeport may produce the first clear legal precedent. It was filed last spring by a woman seeking $150 in tuition, the cost of her books, and legal fees because a course required of secondary education majors was "worthless" and she "didn't learn anything." A law review has been sued for rejecting an article. In New Jersey, a federal judge has ordered twenty-eight state Senators to stand trial for violating the constitutional rights of the twenty-ninth member, a woman, by excluding her from their party caucus. They did so becaue, they claimed, she was "leaking" their deliberations to the press. In a Columbus, Ohio, test case, the U.S. Supreme Court recently ruled that secondary-school students may not be suspended, disciplinarily, without formal charges and a hearing, that the loss of a single day's education is a deprivation of property. A federal court in Washington has just awarded $10,000 to each of the thousands of May, 1970, anti-war demonstrators whom it found had been illegally arrested and confined at the behest of Attorney General Mitchell.

Aside from the merits of any particular case, the overriding fact is clear that the hands of all administrators are increasingly tied by real or potential legal issues. I find I must consult our lawyers over even small, trivial decisions. The university has so many suits against it (40 at last count) that my mother now calls me, "My son, the defendant."

The courts and the law are, of course, necessary to protect individual rights and to provide recourse for negligence, breach of contract, and fraud. But a "litigious society" presents consequences that nobody bargained for, not least the rising, visible expense of legal preparation plus the invisible costs of wasted time.

Far more serious than expense, however, is the confusion, ambiguity, and lack of subtlety of the law and what that does to institutional autonomy and leadership. To take the example of consumer protection, we see that lawsuits are forcing universities to insert a railroad-timetable disclaimer in their catalogues — e.g., "Courses

in this catalogue are subject to change without notice" — in order to head off possible lawsuits. At the same time, the Federal Trade Commission is putting pressure on doctors, architects, lawyers, and other professionals to revise their codes of ethics forbidding advertising. The Buckley amendment, which permits any student to examine his own file, tends to exclude from the file any qualitative judgments which would provide even the flimsiest basis for a suit.

The confusion, ambiguity, and complexity of the law — augmented by conflicting court interpretations — tend toward institutional paralysis. Equally forbidding is the fact that the courts are substituting their judgments for the expertise of the institution. Justice may prevail but at a price to institutional leadership so expensive, as we shall see, that one has to ask if the "wool is worth the cry."

One for the Seesaw

The incessant external forces and the teeming internal constituencies, each with their own diverse and often contrary expectations, demands, and pressure, are difficult enough for any leader to understand, let alone control: at their best, leaders serve as quiet and efficient custodians.

The problem is made infinitely more complex when the goals and values of the internal and external forces seem not merely divergent, but irreconcilable. Their collision, or "boundary clash," tends to isolate or crush the "man at the top."

The College of Medicine of a large urban, but state affiliated, university accepts 187 applicants out of 8,000. Immediately some 23,000 people are angered, the rejected applicants and their parents. Although admissions decisions are the prerogative of the faculty, the president of the university finds himself deluged by phone calls and letters from parents, alumni, friends of the regents, and legislators. He feels, however, that "The president shouldn't butt in. . . ." Meanwhile, the issue grows more political. Disgruntled persons write their legislators. The legislators demand an informal commitment that the College of Medicine accept only state residents. Next they propose a bill that only state residents receive support. The president is forced to become involved. He talks to the governor, the legislators, and the media, and he amasses political support to oppose the state-only bill. Eventually, the bill is dropped.

The legislators provide a large share of the revenues of this university (which happens to be the University of Cincinnati — but it could be legion), and their support has a direct relation to how their constitutents react to our internal decisions. Patronage structures blanket the social geography of our environment, as they do that of other institutions. Whether these structures consist of taxpayers or consumers, they are demanding, often fickle, and always want their way. In any case, their generosity or miserliness reflects the degree of respect which they feel for the institution, and whether they like what we are doing for them or their relatives. It's as simple as that.

Let me cite a classic confrontation between these internal and external constitutencies, mirroring a divergence in their goals and values. It concerns the policy of "open admission" which has created bewilderment and confusion on many campuses. Open admission makes it difficult to understand what we're about, what our "basic" mission is. It makes it almost impossible to define with any precision the educational stands that we must take from time to time. It's hard to determine just what students need or want and what our responsibility to them should be. As one Appalachian student told his humanities professor: "Sure, I'll be glad to read Dante with you, as soon as everybody in my family has a pair of shoes."

The public's uneasiness is often verbalized through code words or phrases (at least according to my mail and the letters-to-the-editor columns) like "lowering of academic standards" or "cheapening the degree." These concerns often (but not always) reflect the public's foreboding about mass education and its concomitant, "equal opportunity" for minorities and women in higher education. While "Affirmative Action" is the mandated vehicle for implementing equal education and work opportunities, in practice it has proved to be more a case study of how difficult it is to force profound changes in an institution as complex, prestigious, slow-moving — and sensitive to economic forces — as a university.

Whatever the reality of Affirmative Action, some citizens are uneasy about this development and use the rhetoric of "lowering standards" or "quotas" to question sharply its validity. And to make matters more complicated, another, increasingly vocal, group feels dissatisfied at the seeming lack of progress. Each of these viewpoints is held by our various publics, and this in turn leads to a situation where "both sides" are dissatisfied with our progress — some because we are doing too little, others because we are trying too much. In either case, we are in the middle and neither side is happy with the university. Or its president.

The university is, in a sense, an anvil on which a fragmented society hammers.

MIT '77

Articles

Departments

$9 Million from the Pew Trust Is the Base Grant for a $25.5 Million Health Center

Plans for a $25.5 million center for health sciences and health services at M.I.T., and a base grant of $9 million from the Pew Memorial Trust of Philadelphia to support its construction, were announced at a meeting of the M.I.T. Corporation on March 4.

Two major buildings to be built on Carleton Street, between Main and Amherst Streets on the East Campus, will house laboratories in physiology, human biology, and experimental medicine; programs in health care planning and management; and M.I.T.'s work under the Harvard-M.I.T. Program in Health Sciences and Technology.

Howard W. Johnson, Chairman of the Corporation, says the health sciences and technology are fields "clearly of great national importance," and M.I.T.'s new center will be "a truly unique national resource for the more effective and powerful development of all the interrelated health fields." He's confident that the importance of the Institute's opportunity in this field will be persuasive and that the balance of the needed funding will soon be available.

The grant announced in March is the second major gift of the Pew Memorial Trust to M.I.T. The Fuels Research Laboratory in the Ralph Landau Building for chemical engineering was made possible by a $1.25 million grant in 1974. The Trust was established by the surviving children of the late Joseph N. Pew of Philadelphia, who founded the Sun Oil Co. in 1886. Seven members of the Pew family through three generations have attended M.I.T.

With the Pew grant, M.I.T.'s five-year, $225 million Leadership Campaign announced just two years ago — in April, 1975 — stands half way toward its goal. Campaign objectives included $45.7 million for new academic facilities.

W. B. Murphy

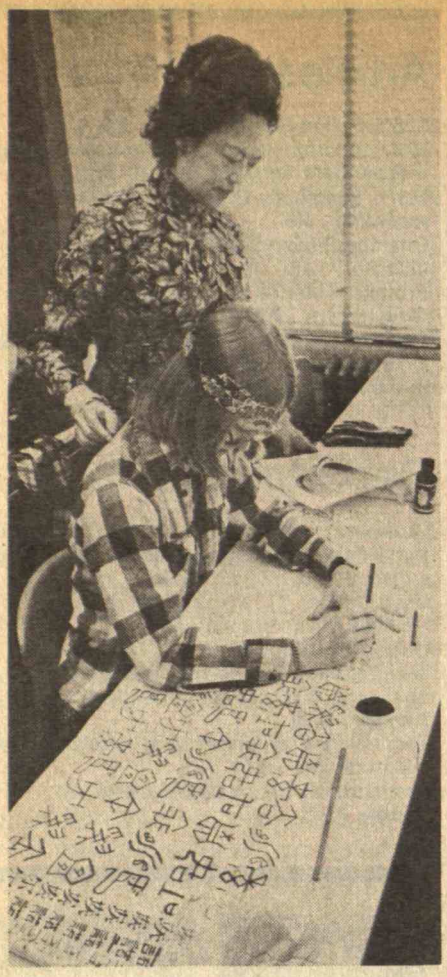
E. O. Vetter

New Leaders Join the Campaign

William B. Murphy, former President and Chief Executive Officer of the Campbell Soup Co., and Edward O. Vetter, '42, formerly Vice President of Texas Instruments, Inc., and more recently Under Secretary of Commerce in President Gerald R. Ford's administration, have been named Co-Chairmen of M.I.T.'s $225 million Leadership Campaign.

As Co-Chairmen, they join Paul F. Hellmuth, '47, who has served in a similar role since the Campaign was announced in April, 1975.

Howard W. Johnson, Chairman of the Corporation, says Mr. Vetter and Mr. Murphy "bring important added strength to our Leadership Campaign organization, and we welcome their assistance and support." Both are members of the M.I.T. Corporation, and Mr. Vetter is this year serving as President of the Alumni Association.



Ringing the Bells of Old North Church

Eight bells hang in the tower of Boston's Old North Church — the same historic tower from which Paul Revere's lanterns were hung. They're the oldest bells in America installed especially for "change ringing." And today they're sounded at least once a month by M.I.T. students *(see photo, opposite page)*.

"Change ringing"?

Sound all the bells in a series of as many different sequences as possible — the series forming what is called a "peal." With eight bells, the number of sequences is eight factorial (8!), well over 5,000; and a "peal" takes at least three hours of continuous ringing.

That's what happens at the Old North Church on the second Sunday of each month, the project of the M.I.T. Guild of Bell Ringers. It all started during the 1975 Independent Activities Period, when several undergraduates were attracted to a course entitled "Introduction to the Art and Science of Change Ringing." The course has been repeated each year during I.A.P. to renew the Guild's membership, and this year eight students enrolled for three sessions each week.

Independent Activities Period: A Month of More Opportunities and Less Pressure

The Independent Activities Period — a one-month between-terms interval for independent study, "a time of freedom from the pressures of the regular semesters," comes before the faculty for review this spring; and the odds are very strong that it will be continued as a permanent — non-experimental — feature of the academic year.

The First Term now ends with final examinations just before Christmas, and the Second Term begins at the end of January. During the four weeks in between, everyone at M.I.T. is invited to share his own interests with others in group activities and seminars. In addition, many students do independent study and research, some for academic credit; and a few make up deficiencies or take concentrated courses, also for credit.

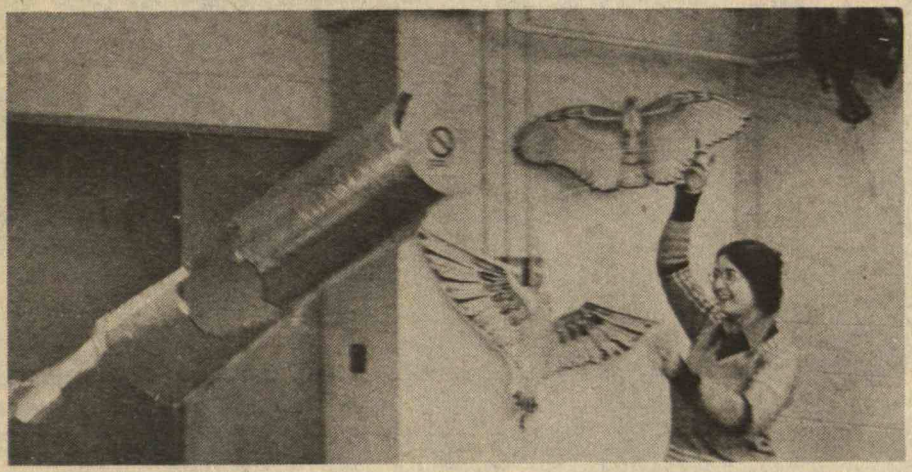
Though no one is required to be on the campus during the month, the I.A.P. committee estimates that over 80 per cent of the students and faculty have been on hand for at least part of the month during the seven years since I.A.P. was first organized in 1971. Joel Orlen, Assistant to the Provost who is Chairman of the I.A.P. committee, thinks I.A.P. and its counterparts at other educational institutions are "one of the most solid of the educational innovations of the early 1970s." M.I.T.'s month is popular with "a very, very large majority of students," he thinks, and "the rich variety and large numbers of activities have to be testimony to something."

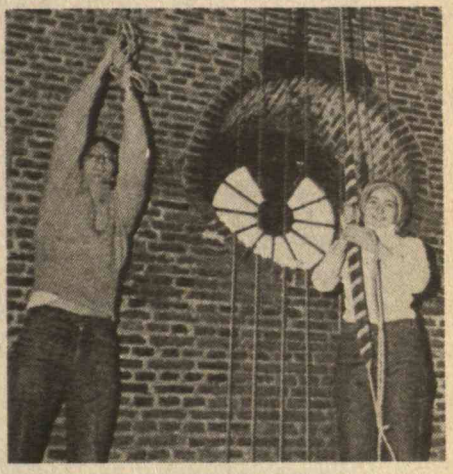
From Ping Pong to Superheavy Elements

The "fun and games" aspects of I.A.P. are likely to be emphasized in publicity, and that distorts the view that many have about this one-month period of freedom from rigorous scheduling. It happened this year, too; there was a "College Bowl," a table tennis tournament (the winners are going to the New England Intercollegiate Championships), a winter mountaineering school run by the Outing Club, and classes in disco dancing, motorcycle maintenance, kites and kite-flying, and wine tasting, to name but a few.

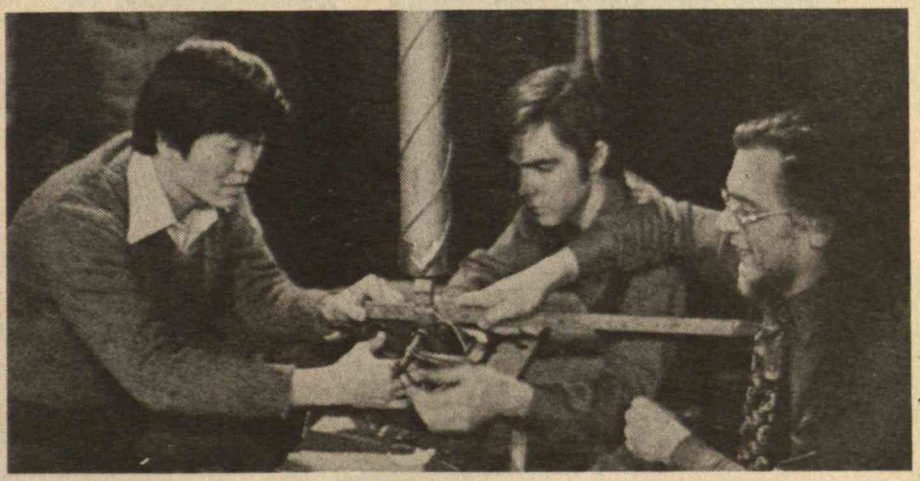
But among more than 500 activities listed in this year's final guide were some first-rate professional experiences which would have been denied most students by term-time schedules: a chance to study and begin to design experiments for the Space Shuttle, with Professor James W. Mar, '41; a course in industrial energy conservation to test a "continuing education" package being developed in the Department of Chemical Engineering; research on minicomputer software systems with Professor Roy Kaplow, '54, in the Department of Materials Science and Engineering; a series of lectures on meteorology for nonmeteorologists; a workshop on third-world climate and food problems led by Professor Reginald Newell, Sc.D. '60, tours of "the real world of nuclear engineering," including visits to the Pilgrim Station and the Boston offices of Stone and Webster Engineering Corp.; a week-long symposium on archaeoastronomy arranged by Professor Kenneth Brecher, '64; three seminars on "The Search for the Superheavy Elements" by Professor Lee Grodzins; lectures on consultants and how they work; fourteen sessions on system dynamics by Professor Jay W. Forrester, S.M. '45, and his associates; and a half-day symposium summarizing results from the M.I.T. x-ray observatory aboard the Third Small Astronomy Satellite.

It's in such activities and explorations, says Dr. Orlen, that many formal academic activities gain momentum, and he thinks many students use I.A.P.-initiated projects for undergraduate theses and even to guide their interests in graduate study. Faculty members use it to experiment with teaching and research methods — and to recruit students for their special passions. Dr. Orlen uses adjectives like "balanced," "responsive," and "vigorous"; I.A.P., he says, is so much a part of the experience of a year at the Institute that it's "built into our neurons."





All kinds of experiences awaited those who attended the Independent Activities Period in January. There were countless lectures and seminars, but photographers were attracted by the visual things: Chinese calligraphy (opposite), dulcimer building, physical fitness, kites and kite-flying, bell-ringing (see story, opposite), and wind tunnel instrumentation. (Photos: Calvin Campbell)



A New Recording Confirms the Excellence of M.I.T.'s Symphony

"We thought we were at Juilliard — this year, the freshmen and graduate students were so good. Each one was more brilliant than the next," recalls Professor David Epstein of last fall's auditions for the M.I.T. Symphony Orchestra, of which he is Conductor.

M.I.T.'s image is changing. And it is particularly apparent in the growth of the Orchestra (there were more candidates this year than positions). From an ordinary college group ten years ago, the M.I.T. Symphony has grown to become a fine orchestra which has played to critical acclaim in major concert halls across the United States, including Carnegie Hall and the Kennedy Center. A sample comment from *The New York Times:* "Shades of Leonardo! There is a new Renaissance in the making. . . . and it was hard to tell the engineers, physicists, chemists or whatever from the musicians, everyone having played so well. It was a concert that would have been a credit to a professional orchestra."

Now, that judgment has been confirmed by Vox Productions, Inc., of New York City, which last month released into the commercial record market the first of four discs recorded by the M.I.T. Symphony Orchestra under Professor Epstein. The series will include some works that have never been recorded before: Ernest Bloch's *Suite Hébraique* in the composer's orchestrated version, Frank Martin's *Sonata da Chiesa* for viola d'amore and string orchestra, and David Epstein's *Night Voices.* The first recording pairs two American works — Aaron Copland's Dance Symphony and Walter Piston's Suite from "The Incredible Flutist"; it's now on sale in record stores on the Vox/Turnabout label, number QTV-S 34670, at $3.98 in music stores, and at a discount price of $2.90 at the Coop. Mail orders are being filled by the Tech Store of the Harvard Cooperative Society, 84 Massachusetts Ave., Cambridge, Mass. 02139. The second disc is expected this spring, the third next fall. It's the first time a collegiate orchestra has been selected to appear without subsidy on a major record label.

Putting Culture on a Strong Footing

Says David Epstein: "A different kind of student is attracted to M.I.T. The orchestra helped to develop the idea that culture is on a strong footing here."

About one third of the M.I.T. student body participates in music courses, many of them using music as a "minor." "We want the remarkable young person who is interested in science but wants to pursue music as a serious lifelong study," explains Professor Epstein. "Some say they don't know which to choose, and at M.I.T. they can do both." A few find they want to switch into music from another major for their bachelor's degrees. Others parlay their musical talent and interests into interdisciplinary programs: music and psychology, biology, philosophy, and linguistics. An example: music involves the precise control of time, and it involves psychology and physiological perception of time. Students are working on the development of theories to describe musical perception and the cognitive processes used in structuring and processing musical time. There is often a problem in interdisciplinary work, says Professor Epstein: people in different fields don't know how to talk to each other; but the common interest in music helps to overcome that inherent difficulty. — *M.L.*

James J. Heeger, '78, President of the M.I.T. Symphony Orchestra, a violinist, presents Boston Pops Conductor Arthur Fiedler with the first of four records made by the Orchestra on the Vox/Turnabout label. The first record marked the recording debut of the Orchestra under the direction of Professor David Epstein. (Photo: Calvin Campbell)

"Here You Play in so Many Groups you Can't Help but Improve."

When James Impara, '78, applied to college, his first priority was a school with a good architectural program. But he was also a musician, and when he saw the M.I.T. orchestra on television he realized that M.I.T. offered not only a good architectural program but a comprehensive music program.

He has played with the M.I.T. Symphony Orchestra since his freshman year and also performs with the M.I.T. Chamber Players. "Here you play in so many groups you can't help but improve," he says. "The area where you improve is in performance. Had I gone to a conservatory, I don't think I would have had any more orchestral performance experience."

Mr. Impara was one of 13 orchestra members to enter a concerto competition held this winter. He prepared for the audition last summer by practicing during his job as a nightwatchman. (He discovered that the time passed more quickly playing his French horn and that the noise kept people away from the building.)

As the winner, he played his French horn in a concerto of his choice — Mozart's French Horn Concerto No. 3 in E flat Major K. 447 — in concerts at Wellesley and M.I.T.'s Kresge Auditorium. It was his first time as an orchestra soloist. His description of this opportunity: "Fantastic!"

". . . very enthusiastic and dedicated performers" is the way Professor Marcus Thompson (top left, opposite) describes his students in the M.I.T. Chamber Music Society. "Chamber music" is broadly defined; during the Independent Activities Period, for example, musicians signed up to play many different instruments in different groups, and for an eight-hour chamber music reading party Building 14 reverberated with music from basement to fourth floor; as you walked down the hall you could hear a variety of sounds coming from all directions. "They work better if they know they have a performance," says Professor Thompson — hence the search for stimulating and unusual sites, including the Lobby of Building 7 at midnight (above). (Photos on pages A4, A6, and A7: Roger N. Goldstein, '74, and Marjorie Lyon)

Chamber Music Society: Small Groups Unlimited

For students who find the Symphony Orchestra (*see page A5*) too formidable or too formal, there are a host of alternatives in the music scene at M.I.T.: the M.I.T. Chamber Music Society (and the M.I.T. Chamber Players), the choral society, two jazz bands (winners of numerous jazz competitions, national and international), musical theater, and informal music.

Marcus Thompson, Associate Professor of Music, came to M.I.T. three and one-half years ago to develop chamber music. It provides a different — really unique — experience, he says: "Chamber music is whatever you define it to be, and I've used the broadest definition possible: music for ensembles where there is one person per one part. So you can have an almost unlimited number of ensembles — piano, clarinet and viola, or violin and piano, or two people playing the same piano, or two flutes and harpsichord, for instance, in groups of up to 13 players."

The M.I.T. Chamber Music Society is an umbrella cover for a number of musical groups, arranged according to the players' interests, ability, and experience. Approximately 60 people are involved — "about what we can handle," Professor Thompson says. "Chamber music doesn't attract the masses — musicians or listeners — but it attracts very enthusiastic and dedicated performers."

All of these small groups have the opportunity to perform in the music library Wednesday afternoons at 5:15. "They work better if they know they have a performance," says Professor Thompson. The "elite" of the Chamber Music Society is the M.I.T. Chamber Players, a group of faculty, students and professionals of exceptional ability and experience, who concentrate on performing challenging music. The purpose is threefold: to give especially gifted students a chance to attain their full potential, to let people see students of that caliber, and to give the players and the audience exposure to a wider area of music. Professor Thompson feels it is important for good players to play with excellent professional players because they learn from others in the group. "The M.I.T. Chamber Players gives students a marvelous opportunity to work as professionals," he adds. His role with the Chamber Players: to coach as an outside listener or as in inside player, or to conduct.

Mastering an Instrument as a Machine

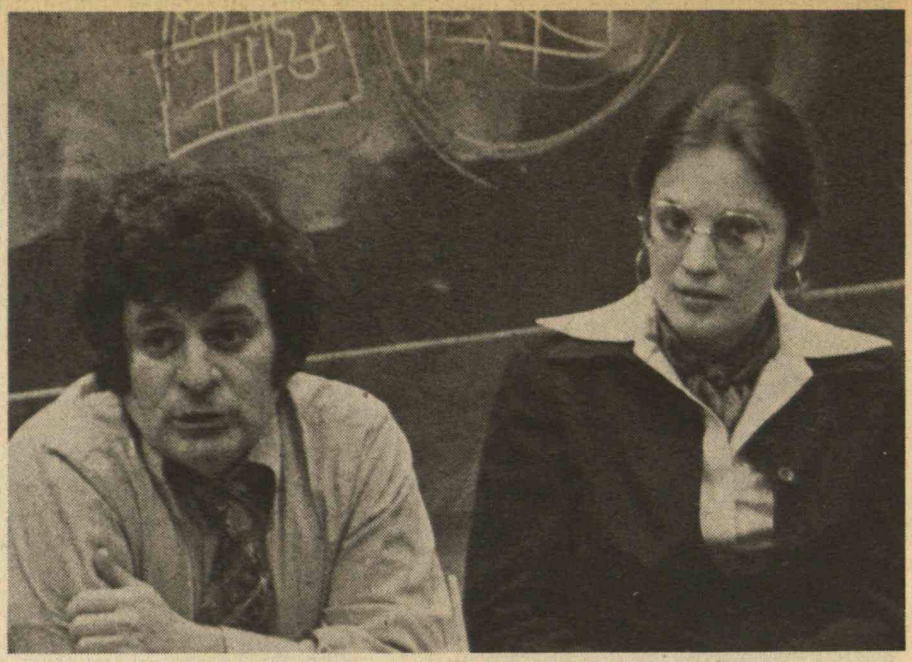
"The best musicians are great athletes, needing strength and dexterity to use the mechanics of the instrument. You have to see your instrument as a machine that has capabilities, and then master it to produce those capabilities."

After more than three years here, Professor Thompson feels M.I.T. is different from his past involvements, including Juilliard and the New York High School of Music and Art, because the school emphasis is not in his area. But it is not different in one important respect: he finds people here that are intensely interested in *something* — there is more of a "graduate school" seriousness in the undergraduate students, he says.

"The best musicians are great athletes, needing strength and dexterity to use the mechanics of the instrument," explains Professor Thompson. "You have to see your instrument as a machine that has capabilities, and then master it to produce those capabilities. (Yet there are limits to each instrument's potential — a finite stretch of bow on the violin, only so much breath for a singer.)"

How to join the orchestra or Chamber Music Society? Auditions are held in September to determine general categories of ability. Students play a prepared piece and read music. "The way they play their instrument is the most important," says Professor Thompson. "We try not to reject anyone unless he or she is so inexperienced that we can't match them. The level of people applying continues to improve." — *M.L.*

Back on the campus to report on their internship experiences in state and local governments, M.I.T. students meet with Professor Martha Weinberg and her guest, Judge Albert Kramer of Quincy District Court. (Photo: Roger N. Goldstein, '74)



Professor Martha W. Weinberg: "I Will Do Everything in my Power to Persuade my Students that Government Is an Honorable Profession . . ."

"These are very brave kids working in a strange new world." Professor Weinberg's goal is to make that world less strange to more and more M.I.T. students — and so to make government a little less frustrating for the rest of us.

Why are governments so frustrating, apparently unable to solve our problems, sometimes even creating new problems while failing on the old ones?

Four important reasons, says Martha W. Weinberg, Assistant Professor of Political Science:

☐ We give government our most controversial, intractable problems, and we expect miracles of efficiency, equity, wisdom, and economy in their solution.

☐ We set many different standards by which to judge government's performance: some of us want prompt, personal service; some of us emphasize the rule book; and some of us emphasize results. Everyone who deals with government is an expert on the response which government ought to make to his need.

☐ The popularity of government seems to depend on its dynamism — its ability to propose new solutions, new programs, new "new deals." But the tough jobs we give government often require slow, systematic change. If governments are subject to re-election every four years, how can change be consistent enough to yield results?

☐ We isolate government from the help it needs to do its job; academics and public officials don't communicate very well, and few of our top college graduates think of government as a career.

Convinced that this gap of understanding, communication, and respect between academics and their civil servants is keeping government from getting help from many people qualified to provide it, Professor Weinberg gave up a job in state government two years ago to join M.I.T.'s faculty in political science. She talks with compelling intensity about her goal: to convince and equip some of M.I.T.'s best students to go to work in government, where Professor Weinberg thinks they're most needed. "I will do everything in my power to persuade my students that government is an honorable profession," Professor Weinberg told an alumni seminar group this winter, "and that there are important problems which can be seriously studied on their merits."

M.I.T. provides some of the finest technical training in the world, and this kind of training is a necessary prerequisite to an entré to decision-making in many areas of public policy. For example, she says, its hard to influence medical care policy without knowing medicine.

But that's not enough. Most of the frustrations with government which Professor Weinberg catalogs occur because of the complexity of what she calls the political environment — an added dimension which complicates whatever government service a professional tries to render. The way to teach this dimension is by immersion, says Professor Weinberg — the "sink-or-swim" method. That's the idea behind the course numbered 17.26 in the M.I.T. catalog — "State and Local Government Internships," which Professor Weinberg teaches with Professors Alan A. Altshuler, former Secretary of Transportation in Massachusetts. Students take part-time jobs (eight hours a week) in government agencies and report on their experiences in every-other-week seminars.

Last year one student worked on a system for collecting some of Boston's delinquent real estate taxes, another became "the expert" on solid waste management on the Boston Harbor islands when they were added to the state park system, a third worked on reform of the administrative system for the Quincy courts.

These are "very brave kids," says Professor Weinberg, working in "a strange new world." Her goal is to make that world less strange to more and more M.I.T. students — and so to make government a little less frustrating for the rest of us. — *J.M.*

An "Incredibly Positive Response" to the Alumni Fund–"Beyond all Expectations" to Date

M.I.T. alumni are coming forward in record numbers — and with unprecedented generosity — to promise an all-time record for the 1977 Alumni Fund.

As of February 1, over $2.8 million had been given to the Fund; that's a 50-per-cent increase over the dollar amount at the same time last year. Some two-thirds of the contributors to the 1977 Fund have increased their gifts over the previous year, about half of them making possible additional funds for M.I.T. from the Challenge 77 program. And the number of contributors is up by about 21 per cent over last year.

(The Challenge 77 program, announced in the fall, provides for additional gifts to M.I.T. from a $500,000 pool established by an anonymous donor; increases over last year of between $25 and $1,000 in giving by any alumnus are matched, dollar for dollar, from the Challenge 77 pool.)

"Challenge 77 has performed beyond all our expectations," says Fred G. Lehmann, '51, Director of the Alumni Fund — "an incredibly positive response" in both the number and amount of Alumni Fund gifts in support of M.I.T.'s on-going $225 million Leadership Campaign.

There has been a substanital increase in the amount of unrestricted giving to the 1977 Alumni Fund, says Mr. Lehmann — a response, he thinks, to the emphasis on unrestricted giving in the Leadership Campaign.

Such unrestricted funds are increasingly important: they give the Institute flexibility to encourage new educational programs that help maintain leadership and vitality — the main goal of the Leadership Campaign.

The Alumni Fund is committed to a growth rate of 15 per cent per year for the next five years — a doubling of the dollar amount of the Fund between 1975 and 1980. The 1977 results thus far put the Fund well ahead of schedule — "greatly exceeding our projected goal," says Mr. Lehmann.

Though they're buried by unexpected quantities of mail, Mary Hillis (left) and Judy DiGennaro are smiling: the envelopes contain contributions to the 1977 Alumni Fund, which is turning in an all-time record performance. A total of $1.8 million, 30 per cent more than last year, was recorded by February 1.

SPECIAL REDUCED ALUMNI RATES

THIRTEENTH ANNUAL TOUR PROGRAM — 1977

1977 marks the thirteenth year of operation for this unique program of tours, which visits some of the world's most fascinating areas and which is offered only to alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Univ. of Pennsylvania, Columbia, Dartmouth, and certain other distinguished universities and to members of their families. The tours are designed to take advantage of special reduced fares offered by leading scheduled airlines, fares which are usually available only to groups or in conjunction with a qualified tour and which offer savings of as much as $500 over normal air fares. In addition, special rates have been obtained from hotels and sightseeing companies.

The tour program is consciously designed for persons who normally prefer to travel independently and covers areas where such persons will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine as much as possible the freedom of individual travel with the convenience and savings of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest. Each tour uses the best hotel available in every city, and hotel reservations are made as much as two years in advance in order to ensure the finest in accommodations. The hotels are listed by name in each tour brochure, together with a detailed day-by-day description of the tour itinerary.

The unusual nature and background of the participants, the nature of the tour planning, and the quality of the arrangements make this a unique tour program which stands apart from the standard commercial tour offered to the general public. Inquiries for further details are invited.

AEGEAN ADVENTURE

23 DAYS $2250

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean and Asia Minor, including not only the major cities but also the less accessible sites of ancient cities, together with the beautiful islands of the Aegean Sea. Visiting Istanbul, Troy, Pergamum, Sardis, Ephesus and Izmir (Smyrna) in Turkey, Athens, Corinth, Mycenae, Epidauros, Nauplion, Olympia and Delphi on the mainland of Greece, and the islands of Crete, Rhodes, Mykonos, Patmos and Santorini in the Aegean. Total cost is $2050 from New York. Departures in April, May, July, August, September and October 1977. (Additional air fare for departures in July and August.)

SOUTH AMERICA

28 DAYS $2675

From the towering peaks of the Andes to the south Atlantic beaches of Rio de Janeiro, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America. Visiting Bogota, Quito, Lima, Cuzco, Machu Picchu, La Paz, Lake Titicaca, Buenos Aires, the Argentine Lake District at Bariloche, the Iguassu Falls, Sao Paulo, Brasilia, and Rio de Janeiro. Total

cost is $2675 from Miami, $2691 from New York, with special rates from other cities. Departures in January, February, March, April, May, July, September, October and November, 1977.

THE ORIENT

29 DAYS $2645

A magnificent tour which unfolds the splendor and fascination of the Far East at a comfortable and realistic pace. Visiting Tokyo, the Fuji-Hakone National Park, Kyoto, Nara, Nikko and Kamakura in Japan, as well as the glittering temples and palaces of Bangkok, the metropolis of Singapore, the fabled island of Bali, and the unforgettable beauty of Hong Kong. Optional visits to the ancient temples of Jogjakarta in Java and the art treasures in the Palace Museum of Taipei. Total cost is $2645 from California with special rates from other points. Departures in March, April, May, June, July, September, October and November, 1977 (extra air fare for departures July through October).

MOGHUL ADVENTURE

29 DAYS $2575

An unusual opportunity to view the magnificent attractions of India and the splendors of ancient Persia, together with the once-forbidden Kingdom of Nepal. Visiting Delhi, Kashmir (Bombay during January through March), Banaras, Khajuraho, Agra, Jaipur and Udaipur in India, the fascinating city of Kathmandu in Nepal, and Teheran, Isfahan and the palaces of Darius and Xerxes at Persepolis in Iran. Total cost is $2575 from New York. Departures in January, February, March, August, September, October and November, 1977.

THE SOUTH PACIFIC

29 DAYS $3140

An exceptional tour of Australia and New Zealand, from Maori villages, boiling geysers, ski plane flights and jet boat rides to sheep ranches, penguins, the real Australian "Outback," and the Great Barrier Reef. Visiting Auckland, the "Glowworm Grotto" at Waitomo, Rotorua, Mt. Cook, Queenstown, Te Anau, Milford Sound and Christchurch in New Zealand and Canberra, Melbourne, Alice Springs, Cairns and Sydney in Australia, with optional visits to Fiji and Tahiti. Total cost is $3145 from California. Departures in January, February, March, April, June, July, September, October and November 1977.

EAST AFRICA

23 DAYS $2310

The excitement of Africa's wildlife and the magnificence of the African landscape in an unforgettable luxury safari. Visiting Lake Naivasha, Lake Nakuru, Samburu Reserve, Treetops (Aberdare National Park), Masai-Mara Reserve, the Serengeti Plains, Ngorongoro Crater, Nairobi and Mombasa. Total cost is $2310 from New York. Optional visits are available to the Amboseli and Tsavo National Parks, the Victoria Falls, on the mighty Zambezi River between Zambia and Rhodesia, to Zanzibar, and to the historic attractions of Ethiopia. Departures in January, February, March, May, June, July, August, September, October, November and December 1977.

MEDITERRANEAN ODYSSEY

22 DAYS $1925

A unique and highly unusual tour offering a wealth of treasures in the region of the Mediterranean: Tunisia, with the ruins of Carthage and many other Roman cities as well as lovely beaches, historic Arab towns and desert oases; the beautiful Dalmatian Coast of Yugoslavia, with its fascinating and medieval cities; and the 17th and 18th century splendor of Malta. Visiting Tunis, Carthage, Dougga, Sousse, Monastir, El Djem, Gabes, Djerba, Tozeur, Sbeitla, Kairouan and Thuburbo Majus in Tunisia; Split, Trogir, Sarajevo and Dubrovnik on the Dalmatian Coast of Yugoslavia, and Valletta and Mdina in Malta. Total cost is $1925 from New York. Departures in March, April, May, June, July, September and October, 1977 (additional air fare for departures in June and July).

* * *

Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes.

Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1978 are also available.

For Full Details Contact:

ALUMNI FLIGHTS ABROAD

White Plains Plaza
One North Broadway
White Plains, N.Y. 10601

Five Ways to Realize the Song's Dream: "Take Me Back on a Special Train . . ."

Five challenges to M.I.T.'s Alumni Association in the next decade, and fulfilling them is "paramount to the future of M.I.T.," says Edward O. Vetter, '42, President of the Alumni Association:

☐ Build a strong volunteer organization nationwide, to "translate the pride that most alumni feel in the Institute into a strong and deep commitment to work with and for it," said Mr. Vetter at the Alumni Council's "President's Night" in January. There are localities with intensive activity throughout the country, and Mr. Vetter cited the effective work of the Regional Directors of the Alumni Association in the 18 months since their posts were created, but "we still have a long way to go," he said, to achieve effective local programs in support of the Institute in major centers throughout the U.S.

Build a strong volunteer organization nationwide, to "translate the pride that most alumni feel in the Institute into a strong and deep commitment to work with and for it."

☐ Build the performance of the Alumni Fund to be consistent with the goals of M.I.T.'s $225 million Leadership Campaign. According to the Alumni Fund Board, that means at least 35,000 donors contributing $6 million by 1980; now the record of the 1977 Alumni Fund (*see page A9*) means that these sights may even be raised within the next two years. But there's plenty of room for improvement, said Mr. Vetter: the median gift, now $25, could well be as high as $100 if the unique position of M.I.T. and its benefits to its graduates are in fact to be recognized by alumni contributions to the Fund.

☐ Create a new headquarters — and with it a new role — for the Alumni Association on the campus. The first of these two goals is in fact in process: renovations to Building 10 budgeted to cost at least $1.3 million will give the Association offices, exhibition space, and meeting facilities at the very center of the Institute — a place of high visibility which "will make possible an important new level of interaction among alumni, faculty, and students." Already $200,000 of the $1.3 million goal — which includes remodeling Room 10-250 as well as the areas beneath it on the first floor — has been found, and a committee led by Breene M. Kerr, '51, is hard at work.

☐ Find new ways for alumni to have "continuing intellectual involvement" with M.I.T. Already there are plans for two "summer colleges" in 1977 (*see page A21*), and Mr. Vetter called *Technology Review* "one of the most powerful tools that any university has for continuing intellectual involvement." He hopes for further development of both these programs — and he stressed the need for new ones to bring the Institute's intellectual resources to alumni everywhere.

☐ Develop an "early association" with alumni activities for students at M.I.T. When he was an undergraduate 35 years ago, said Mr. Vetter, he can recall "no concern or expression of interest" on the part of the Alumni Association — and he in turn was totally innocent of its activities and of the opportunities which it would later bring him. Now he wants to change that, and he hopes that the Association's staff and officers will find ways to foster participation of students in alumni affairs as well as of alumni in campus events.

That reference to his recollections of student days brought Mr. Vetter to the song which was popular in the 1940s: "Take me back on a special train to the glorious In-sti-tute," it says — but it expresses a goal of continuing association and fellowship little realized for students then, and still too little realized today. — *J. M.*

After applauded performances at M.I.T. ("I have never seen another campus theatrical group present a cast of such consistent brilliance," wrote David B. Koretz, '79, in The Tech*), M.I.T.'s Shakespeare Ensemble took "The Taming of the Shrew" to equally enthusiastic audiences in five eastern states late in January.*

There were performances arranged by M.I.T. alumni clubs in Madison and Princeton, N.J., Philadelphia, Baltimore, Washington, and Hartford, and there were noontime readings of scenes from the play for high school audiences in three of those areas. It was the most ambitious tour ever attempted by the Ensemble, made possible by support from the Council for the Arts at M.I.T. and the Alumni Association. (Photo: Ephraim Vishniac, '78, from Technique)

James E. Adams, Jr., '77, will be at Oxford University next September with a Rhodes Scholarship — the first awarded to an M.I.T. senior in a decade and the first ever to a student in the Department of Humanities. Travis R. Merritt, Associate Professor of Literature, describes Mr. Adams as "simply first rate. . . . We can't pretend to be astonished that he has received this honor." (Photo: Clavin Campbell from the M.I.T. News Office)

1,000 Freshmen Planned for Fall: a Lively Debate on Overcrowded Housing

The Institute will seek 1,000 freshmen to enter in the Class of 1981 next fall, down from the 1,100 planned for the Class of 1980. Even with the decrease, which was mandated largely by housing shortages, there is potential for "severe" overcrowding in M.I.T. dormitories.

Already 241 potential members of the Class have been identified; they received holiday greetings late in 1976 from Peter H. Richardson, '48, Director of Admissions, in the form of letters of acceptance under M.I.T.'s early action program.

There were 486 "early-action" applicants last fall — some 60 fewer than the record 550 a year earlier. Those not granted admission in December are being reconsidered with other applicants to the Class of 1981 this spring, and all these will have until the normal acceptance date in May to indicate their final decisions on where they will go to school.

Even with only 1,000 new students next fall, the dormitories will have to accommodate 130 students over their nominal capacity as the year begins in September, 1977, according to Kenneth C. Browning, '66, Associate Dean for Student Affairs. That's because increasing numbers of students are choosing on-campus housing instead of Boston-area apartments, and because the departing Class of 1977 will be small — only 893 students at present count. Last fall overcrowding totalled 96, and there has been some outspoken criticism from students affected by the strategies of turning doubles into triples and lounges into sleeping rooms.

But it could be worse: two new housing units will come into full use by the end of next summer. The new Women's Independent Living Group — up to 45 students — and the new M.I.T. Chapter of Alpha Delta Phi will find quarters in an M.I.T.–owned building at 351 Massachusetts Avenue, just south of Central Square. Extensive renovations — the total cost is $500,000 — are now underway.

The Women's Independent Living Group (W.I.L.G.) say they want to "live with other women without the institutional setting of a dormitory . . . . Our main goal is clearly to provide a sense of community," says Beth E. Tavrow, '79, House Manager.

The M.I.T. Chapter of Alpha Delta Phi is largely the result of the work and enthusiasm of the late Henry Leeb, '15, who began the campaign for an A.D.P. chapter as an undergraduate and never gave up; he was finally initiated into another chapter just three weeks before his death nearly a year ago.

Fraternities: Commitment, Cooperation, and a Distant Dark Cloud?

M.I.T. fraternities are at once durable — an invaluable feature of life at the Institute for nearly a century — and fragile — deeply dependent on the support of the Institute and the loyalty of their alumni. And if there are clouds on the horizon, the threat is moderated by the promise of continued commitment of students, alumni, and the Institute made clear during the first-ever joint conference of the Interfraternity Conference and the Alumni Interfraternity Conference this winter.

Paul E. Gray, '54, Chancellor of the Institute who is himself a fraternity man, concluded the meeting with a strong accolade for "the lessons in diversity and self-determination which fraternities provide."

Most of the half-day session was devoted to practical, nuts-and-bolts help for fraternities: how alumni can help them with capital and banking, how M.I.T.'s Department of Physical Plant can help houses secure themselves against fire and theft, how the Institute can help identify community relations opportunities:

☐ Community relations is more than fixing up a settlement house, said Professor Lawrence E. Susskind of the Department of Urban Studies and Planning. Consider a management role in a community organization — addressing envelopes, making telephone calls, organizing a meeting. A "formidable contribution," he said — and at the same time "a valuable lesson in community living."

☐ An alumnus — he turned out to be an official of a local bank — tried to give a conference of chapter treasurers some advice about "NOW" accounts, collecting bills, and

taking discounts. He concluded that helping fraternities could be a good business proposition — "A nice piece of business we're missing," he said.

☐ James A. Champy, '63, Executive Vice President of the Alumni Association, offered some advice about alumni relations: lots of communications, plenty of continuity, occasional events — all valuable as "cultivation" for the all-important support which most fraternity chapters need from their alumni.

☐ "There's never been a loss of life in a fully-sprinklered building in which all systems were operating properly," said John M. Fresina, Director of M.I.T.'s Safety Office; for a typical fraternity, such a system might cost $10,000 to $15,000, he thinks, and the Safety Office will help any fraternity that wants to consider one.

☐ The Sigma Chi house has the lowest house bill of any fraternity that serves meals, thinks James Bidigare, '78, its Treasurer (he's also Secretary of the Interfraternity Conference). But it was not always so. In eight years ending in 1973 the chapter had spent $12,000 more than it took in as rents. Then, with help from alumni, it turned over a new management leaf, and now there's a $6,000 surplus in the treasury.

Dr. Gray closed the conference by listing three reasons for his confidence in the future of fraternities at M.I.T.:

☐ Diversity is a fundamental goal of M.I.T.'s housing system, and the fraternities are an essential element — a "singular component," a voluntary association in which every individual has to make a commitment to the success of the group.

☐ In pragmatic terms, fraternities are indispensable for the housing they provide. To build as many beds as fraternities now provide would cost M.I.T. at least $50 million — an unthinkable sum, said Dr. Gray, but an unthinkable project, too.

☐ Fraternities make an important contribution to the educational process — teaching "how groups work, what it means to be a leader and a follower." That kind of experience, said Dr. Gray, is "almost unavailable" in other forms of housing.

But Dr. Gray warned of "troubled times ahead" for fraternities. He fears that there has been "a steady decline in the quality of physical amenities available to fraternity residents" in the years since he came to M.I.T., and the Back Bay, where most fraternities now own houses, is becoming "increasingly uncongenial." He fears a day when fraternities "cannot compete with other forms of housing" at M.I.T., and he hopes students and alumni can work together to be sure that this "disastrous threshold" is not reached.

For himself, Dr. Gray recalled, his four years as a member of an M.I.T. fraternity "had more impact than anything else in my 27 years at M.I.T." It was his first opportunity "to explore life with a group of peers with different outlooks and values," and it left him with a valuable set of leadership skills and some "important and lifelong associations."

Athletic Facilities Space Crunch

By Dave Dobos, '77

What happens when the size and scope of a program increases dramatically, yet its facilities remain essentially constant? The M.I.T. Athletic Department is currently facing that problem. The combined efforts of students and staff, although temporarily relieving a critical situation can only result in painful choices for M.I.T. athletics in the not-too-distant future, if present trends continue.

The increased athletic participation has hit all four of the organized sports areas. There are now 29 varsity teams (21 men's, eight women's), a net increase of two since September, 1975. Over 900 undergraduates compete on intercollegiate teams, making the M.I.T. varsity sport participation rate one of the highest in the country. Club teams, with nearly 300 athletes, have increased in number to 17.

Intramural participation increased some 29 per cent during the 1975-76 school year to nearly 10,000 competitors. Three new offerings were added, bringing the total to 23 sports now overseen by the student-run program. Among the most popular team sports, schedules and space allocations were drawn up for 142 basketball, 124 softball, 107 volleyball, 70 football, 54 hockey, and 52 soccer teams. Over 6,000 participants competed in these six sports alone.

Although physical education registration recorded a 7.6 per cent decrease in 1975-76, enrollment was still 40 per cent above that of 1973-74. The reduction reversed a 15-year trend of registration increases. Nevertheless, 6,354 students enrolled in 50 different courses. The reason for the decline, which was mainly in the area of non-credit registrations, was probably due to overcrowding in the locker facilities, which makes physical education classes, especially non-credit ones, less attractive. (Last summer, the grossly inadequate du Pont women's locker facility was expanded into that of the men's. To compensate for the men's loss, additional lockers were placed in the hallway with surrounding partitions built for privacy.)

The burden of the increased participation falls on Assistant Director of Athletics John G. "Jack" Barry, who, among other duties, schedules the facilities for all M.I.T. athletic user groups. He has done wonders to assure that every facility is utilized to its potential, but he still must cut and reschedule alloted team-time as new groups enter the scene.

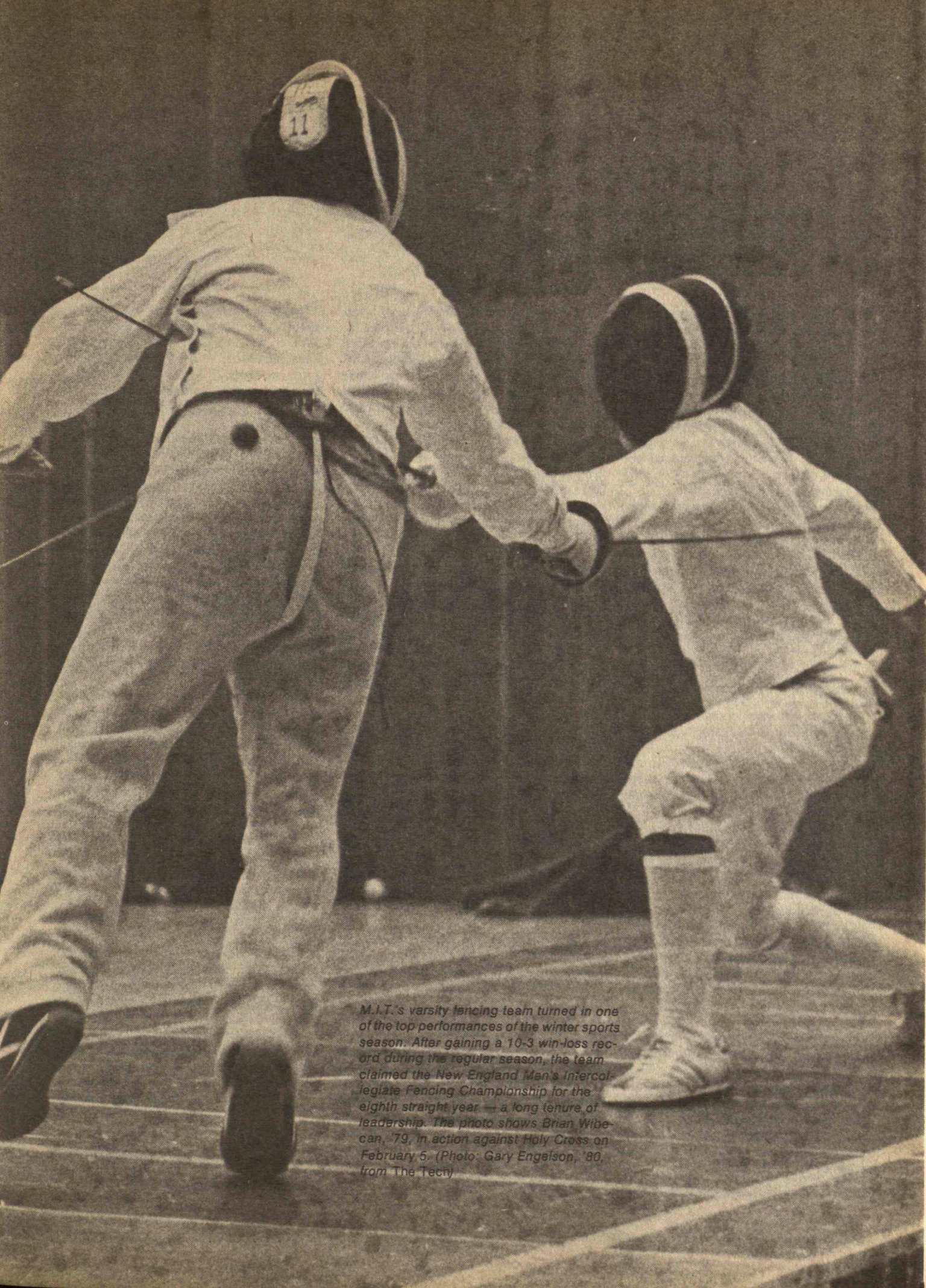
The Alumni Pool has also encountered difficulty. The addition of women's swimming as a varsity sport and its need for practice time has eaten into the hours generally reserved for open swimming. A proposal to hold early morning workouts meets with opposition from coach and athletes alike. It is felt that such an arrangement could result in poor practice attendance and therefore meager meet performance.

The intramural program has been forced to reduce the amount of contests played as the number of teams has increased. Two years ago, "A" league basketball teams completed a ten-game season before post-season play-offs began. This year, teams are scheduled for only six.

The student-faculty-alumni Athletic Board, a presidentially-appointed advisory committee to athletics, has already begun discussing the decisions that will have to be made once the facilities saturation point is reached. The Board has three alternatives, none of which seems desirable. One is to continue the present course, working within the constraints of the system. Another is to re-align facilities priorities to include increased time for larger, less-organized participants at the expense of varsity teams. The final alternative — the most drastic — is the elimination of some user groups from the facilities scheduling. The major question to be resolved is whether it is better to offer a mediocre program to everyone or a quality program to some. In any event, a careful review of each user group must be made in order to assure that every group is fully utilizing its present facility space.

None of these alternatives have to be faced. The new athletic center, which is one goal of the Leadership Campaign, will alleviate most of the acute overcrowding problems. But delays in procuring the necessary funds have postponed its construction. Until additional facilities are built, the first-rate M.I.T. athletic program may be forced to become second-rate.

David A. Dobos, '77, is a principal officer of the Athletic Association and of the Interfraternity Conference; he writes regularly for The Tech and occasionally for Technology Review, and he's a member of the varsity cross-country and track teams. Mr. Dobos will graduate in June with a degree in Economics.



M.I.T.'s varsity fencing team turned in one of the top performances of the winter sports season. After gaining a 10-3 win-loss record during the regular season, the team claimed the New England Men's Intercollegiate Fencing Championship for the eighth straight year — a long tenure of leadership. The photo shows Brian Wibecan, '79, in action against Holy Cross on February 5. (Photo: Gary Engelson, '80, from The Tech*)*

Under the Domes

A New Video System Replicates M.I.T. Classes in Industrial Plants; Academic Credit Is Given

Twenty-nine engineers at three industrial plants are "attending" graduate-level Institute classes — and doing homework, quizzes, and examinations — this spring as if they were in M.I.T. lecture halls. But they're in rooms near their offices, watching videotapes with tutors who are prepared to lead discussions and answer questions.

It's the inaugural test of a new program of Tutored Video Instruction (T.V.I.) now being developed in the Center for Advanced Engineering Study — an experiment patterned after a similar T.V.I. system pioneered by James F. Gibbons at Stanford University, where more than 100 graduate-level courses produced in classes with live student audiences are now available on tape for industrial use.

T.V.I. is different from other video-based "continuing education" systems in three respects:

☐ The tapes are designed to convey the classroom experience as directly and completely as possible.

☐ Students watch the tapes with tutors who are instructed to act as "facilitators," interrupting the presentations for questions and discussion.

☐ Practicing engineers who qualify can attend T.V.I. sessions for academic credit toward graduate degrees from M.I.T. But a thesis, which remains a key requirement for such a graduate degree, cannot be completed by T.V.I., and Professor Paul Penfield, Sc.D. '60, of the Department of Electrical Engineering and Computer Science — in which all this year's experimental T.V.I. courses are being given — says that the number of graduate students who will become degree candidates under T.V.I. will be "limited by the number of faculty available to supervise theses."

The four courses being given this spring on T.V.I. are:

☐ Switching Circuits, Logic, and Digital Design (6.082), Professor Francis F. Lee, '50.

☐ Electronic Instrumentation and Control (6.332), Professor Truman S. Gray, '29.

☐ Electronic Circuits (6.333), Professor Richard D. Thornton, Sc.D. '57.

☐ Introduction to Optical Electronics (6.611), Professor Jeffrey H. Shapiro, '67.

The videotapes are being shown for 29 students (three are enrolled for credit, 26 as noncredit listeners) at three industrial sites: Raytheon Co.'s Equipment Division in Wayland, Mass.; Analog Devices, Inc., in Norwood, Mass.; and Analog Devices Semiconductor Division in Wilmington, Mass.

But that's just a beginning, says John T. Lynch, '63, who has joined C.A.E.S. to be Director of Tutored Video Instruction. He wants to be responsive to industrial needs in expanding the program by next fall into more courses and more departments, and he's actively seeking suggestions from would-be T.V.I. students and sponsoring companies.

T.V.I. tapes are made in M.I.T. classrooms while instructors are teaching their regular M.I.T. students. A camera directly overhead focuses on a desk pad which substitutes for a blackboard, and classroom monitors show the desk pad notes to the class as they're recorded for T.V.I.

The off-campus students meet to watch the video with the same frequency as the on-campus graduate students; they view the same lecture, have access to the same text materials, and compete in every way with the on-campus students. Indeed, according to Professor Gibbons who visited the Institute as the T.V.I. experiment began in February, Stanford's experience is that T.V.I. students do better than on-campus students and better than students taking video courses produced without live student audiences.

The presence of the local tutor, and his ability to stop the tape for discussion and questions, is a crucial difference between T.V.I. and other forms of video instruction, says Professor Myron Tribus, Director of C.A.E.S. The tutor's assignment is to perceive when students are having difficulties and — especially — when there are opportunities to expand on the lectures with local discussion. Thus the pace and content of the courses can be adapted to the needs of the students, leading to "a dramatic improvement in the performance of the students — especially those who are rusty or slow to learn," says Dr. Tribus.

Those interested in future T.V.I. opportunities should write to Mr. Lynch at C.A.E.S., Room 9-321, M.I.T., Cambridge, Mass., 02139.

Exchanging Professional Books

To the Editor:

Here's an addition — a very practical one — to the list of ways for alumni to interact with M.I.T. students (*See* MIT 77 *for December, pp. A9-A10*): a system to enable alumni to recycle (the magic word) textbooks, reprints, journals, and similar material, no longer needed, to others who might benefit from them more. Many of us have large collections of these materials which are not being used and which we will not — in all likelihood — refer to again. Wouldn't it be great if there were some simple scheme whereby we could donate these to some sort of clearinghouse which would make them available to those who could use them?

One recent example: I had a small collection of textbooks, theses, reprints, and journals in this category, which I gave to an M.I.T. departmental library; the librarian said that she would take what she wanted and put the remainder on a table marked "free for the taking." I now have another collection of such material and am about to repeat the process. How about an annual Library Sale Day sponsored by the alumni, to enable us to clean out our home libraries and perhaps help some M.I.T. students in the process?

Donald J. Marshall, '54
Bedford, Mass.

Nancy J. Wheatley, '71, the Alumni Association's Director of Conferences and Special Programs, notes in response that two student groups run book exchanges twice a year at M.I.T. — the Technology Community Association and Alpha Phi Omega — and would be pleased to have such material. If Mr. Marshall's letter stirs further interest among alumni, Ms. Wheatley believes that T.C.A. and A.P.O. will respond.

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I regret to inform you of the death of **Ludwig Rosenstein** on December 13, 1976, in San Francisco, Calif. He was born there on March 29, 1886 and is believed to have lived in that city throughout all (or most) of his life. He prepared at the California School of Mechanic Arts and attended the University of California for a while before entering M.I.T. At the Institute he was a member of the Chemical Society and served on the Executive Committee of the Chess Club and was Institute Editor of *The Tech*. Our class records do not contain information about the professional activities of its members after they have graduated. However, in the 1975 Centennial Edition of the Alumni Register he was listed as a Technical Consultant.

In attempting to find material (on January 15) for class notes for the March/April issue of *Technology Review*, I find it difficult to concentrate on anything but snow. Our first snowstorm came in November and has been followed by a series of other storms (snow, rain, sleet, and freezing rain) up to the time of writing these notes. When he reads these, **Carl Lovejoy** (at Boynton Beach, Fla.) will probably pose his usual question as to why I don't move to sunny Florida and "bask" in the sun. A good question — but I will probably reply, yes, but I like it up here in the North! — **John B. Babcock**, Secretary, 33 Richardson St., Portland, Maine 04103

12

June is just around the corner and with it our 65th reunion. As our President, **Jonathon Noyes** says "Let's make it a real fun time." Let's have a real turnout.

A note from **Rock Comstock** says "I continue in excellent health, though slowing naturally — a bit of arthritis to spice things up — and quite contented with New Hampshire. Although far from enchanted with her winters, I find this country life conducive to serious thought and expression — of which this nation needs more than ever before — since the Civil War, that is."

C.D. McCormack writes, "Think your idea of a class of M.I.T. round-up, is a first rate notice. In looking over the list of survivors I find but two that I have known quite well. **Duyser** and **Louis Flett**. The latter and I used to meet or call on the telephone once in a while, when he was with Stone & Webster. My real friend **Jesse Hakes** died October 5, 1976. My address is not changed but for the winter I am with my son and his wife in Jackson, Tenn. Am in reasonably good health, a little unsteady but no real complaints to dilate upon, except dull hearing, and that's *bad*. Thanks for letter."

Rock and Mac nice to hear from you. Will be looking forward to seeing you at the reunion.

A short note from **Wallace Murray** states that he was ill all last summer and has had to cancel all his activities. Wally, we are indeed sorry that you have been having all this difficulty and hope that you will soon be making a turn for the better.

Chester L. Dows passed away December 28, 1976 at the home of his daughter in Garden City, N.Y. — **Larry Cummings**, Secretary RR 4, Connersville, Ind. 47331

13

The holidays of Christmas and New Year 1977 have come and gone, but we still have warm thoughts on a number of greeting cards and messages from our 1913 Classmates and families.

The **Ellis Brewsters** write: "We had so many for Thanksgiving, we had to split three ways. I only cooked a 23-pound turkey." Jo **Mattson** (Mrs. **William**) and a picture of her dog, Heidi, adds to her greeting: "All is fine for me — I do manage to keep busy." **Ken Blake** states: "Still moving around but not making any promises for '78." Also received cards from Jane and **Henry Glidden** and Della and **David Stern**. Maurine and **Allen Brewer** send their usual newsy letter: "Just 18 months to 1978 and the reunion. Let's keep our 'fingers crossed' and avoid troubles. All fine down here. I'm a great-grandpappy twice now: Allen F. III and Ayame Michele. Both doing fine. Dug into my scrapbook a few days ago and unearthed a Thanksgiving Poem I wrote for the *New York Herald* back in 1919. Showed it to the editor of our local paper and he reprinted it on the editorial page of the Thanksgiving issue, dated November 24, 1976."

Marion Hart and her friend, Louise Sacchi, after spending several days in West Germany, finally arrived at Logan Airport on November 2, 1976, just in time to vote.

Mrs. Weller, whose address is Box 734, Setauket, N.Y., sent us the following note: "The family of **Ernest Weller** want to thank you sincerely for your kind expression of sympathy in the loss of Mr. Weller. He would be pleased and happy that you remembered him. He was a fine gentleman in every way."

Emerson Bray forwarded the sad news of the death of **Robert J. Tullar**, December 19, 1976, caused by a heart attack. *The Philadelphia Inquirer* noted that Mr. Tullar, a native of Waukesha, Wis., and a retired mechanical engineer, died at Delaware County Memorial Hospital in Drexel Hill, Penn., not far from his home at 80 W. Baltimore Ave., Lansdowne. Mr. Tullar retired in 1956 as Manager of the Engineering Services, Electronic Products Division of the RCA-Victor Corp. in Camden. He was a Chief Draftsman of the Heavier-Than-Air Equipment Division of the Naval Aircraft Factory in Philadelphia from 1918 to 1921, when he joined the Victor Talking Machine Co. In 1922, he collaborated with Walter Bloom to design and build the first Victor radio receivers housed in standard victrola cabinets. He became manager of the Engineering Products Department of RCA-Victor in 1945.

He was a member of the Lansdowne Library Board and the Lansdowne-Aldan School Authority and a former member of the Lansdowne School Board. He was a past President of the Board of Trustees of the First Presbyterian Church of Lansdowne and the Union Athletic Association of Lansdowne. He is survived by his wife, Beulah H.; a daughter, Mrs. Jean Watson of Coronado, Calif.; a son, Judge Robert S. Tullar of Tucson, Ariz., six grandchildren and one great-grandson. A note of sympathy has been sent to Mrs. Tullar. Mr. Bray adds his own new address: Apt. C-4, Lansdale Village, York and Green Sts., Lansdale, Penn., 19446.

We wish you all a Happy New Year — **George Philip Capen**, Secretary and Treasurer; **Rosalind R. Capen**, Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

14

Leicester F. Hamilton died in Nashua on December 22, 1976. He had moved there in 1975, after the death of his wife the year before, to be near one of his daughters. Leicester was among four of our classmates who entered the Institute from Medford High School, was with us in all four of our undergraduate years, and was an officer, and finally the colonel, of the M.I.T. cadet regiment. An account of his distinguished career at the Institute after his graduation appears on page A31 of this issue. Leicester was long active in class affairs, was co-manager and Class Marshal of our 50th reunion, and was our Vice President and Treasurer. He was often of great help to the other class officers in representing the class in matters involving the Alumni Association and the Alumni Fund. Many of us will remember his and Alma's gracious hospitality, especially at our 50th and 55th Reunions, during the 25 years they lived close to the M.I.T. campus. They had been married for 56 years at the time of Alma's death. Leicester left two daughters, Mrs. John B. Stevens, of Nashua, and Mrs. David S. Paulsen, of Bethesda, Md.; a brother, Kenneth D. Hamilton, of Audubon, N.J.; eight grandchildren, and nine great-grandchildren. **Walter C. Eberhard**, **Harold S. Wilkins** and I represented the class at the Memorial Services at the M.I.T. Chapel on January 22. — **Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Conn. 06119

15

The many Christmas cards we received from widely scattered classmates and their families were warm reminders that the joy of Christmas is a good deal in living with the memory of fine old friends. There were many pretty and unusual cards. One signed by the *Review* Editor and his staff made me feel they really do care.

Marion Rice wrote, "It would take a week to tell you of my October in the Soviet countries — in a few words, bad weather and frustrations. They did not care for a lone woman traveling in Russia. No telephones were available to me. They want only large groups herded where they want them. How-

ever, I don't regret the trip, even though all I met were traveling businessmen — like being back at M.I.T." Wonderful how Mary gets around.

Many of our widows remembered us. Alice Anderson was in Maine last summer and will spend the winter in Ft. Lauderdale. Others — Lydia Dalton, Beulah Brown (with a box of fine candy from San Francisco), Helen Malone, Virginia Marion, Lucie Murphy and her family. Ethel Romy, Margaret Runels (who spent the summer in the British Isles and attended her 60th reunion at Smith in May), Mary Scully, May Sheils and her family, Molly Swift (great to hear from her), Barbara Thomas and her daughter, Virginia Johnston (Paul is 1921) and Polly Young. Wonderful that they remember our class.

Phil Alger made back home to Schenectady from his tough siege here in the hospital and quickly acquired a fracture that has him in a walker. But he sent his annual cheerful card. **Bert Adams** says he is busy all day from 6:00 am to 10:30 pm and does all his own house work and shopping. How does he do it? **George Easton** writes, "I'm still in disgracefully good health despite my 83-and-a-half years!" **Otto Hilbert** writes, "I am well and continue to be busy with the Corning Glass Historical Record." A warm greeting from **Ben Lapp** in Buffalo (now snowed-in up there).

Sol Schneider says he will be with us here in June. I see **Wally Pike** often and he has not changed a bit. **Sam Tolman** is working part time with a firm of consulting engineers in Boston. **Pop Wood** keeps up his athletic power by lawn bowling at Spalding Inn Club in Whitefield, N.H. I've seen him in action up there during the summer and he's really good.

I come now to that **Jim Tobey**, wintering at Lake Worth in Florida: "I hear that you are suffering with eight feet of snow and zero-degree weather. The lowest daily temperature here has been 68° with a few nights down to low 40s, which you northerners regards as frigid." Then later he wrote he was suffering in the 70° to 76°s, having left 10° back home in Connecticut. Well just after needling us like that Jim must have had a taste of this miserable weather we've been having here. **Wayne Bradley** joined the Snow Birds at Hollywood, Fla., in January.

We have lost a fine old friend and classmate. **Vince Maconi** died January 12 in Hamden, Conn. After graduating in Course I he went to New Haven and joined Aberthaw Construction Co., and subsequently joined the U.S. Bureau of Standards in Washington, D.C. He then, until 1962, served as president and chairman of the board of Dwight Building Co., during which time he was responsible for many major building projects in the New Haven area. These include Grace-New Haven Community Hospital Memorial Unit, the original Grace Hospital, Sterling Hall of Medicine, Yale Medical Library, the Greeley Laboratory of the Yale Forestry School and the Yale Health Department. He was also responsible for the Yale Baseball Field, Strathacona Hall, several Yale secret societies, Southern New England Telephone Co. headquarters, St. Thomas' Episcopal Church, Spring Glen Congregational Church, and several major renovation projects including Trinity Church on the Green and United Church. A licensed professional civil engineer, Vince served on the engineering advisory council of the University of New Haven, and in recent years was secretary and member of the board of Maconi Construction Co. He was formerly a director of Grace-New Haven Hospital, a former member of the Quinnipiack Club, past president of the New Haven Kiwanis Club, a 50-year member of the New Haven Country Club. His son Richard is Course II, 1944. The sympathy of our class goes to hiw widow Marion. Vince was always a regular and generous supporter of all class and alumni activities and we'll miss him.

Roland Baldrey IV died November 1, 1976 in Arlington, Mass.

We'll have our annual Class Cocktail party and dinner at the M.I.T. Faculty Club in Cambridge on the afternoon of Alumni Day, June 10. Plan to be there. — **Azel Mack**, Secretary, 100 Memorial Dr., Apt. 26A, Cambridge, Mass. 02142

16

Willard Brown starts us off with this happy comment: "We consider ourselves two very lucky people. Recent physical check-ups showed simply nothing of import, so we continue our very active lives in this halcyon spot for retired folks." Willard and his wife, Dorothy, are living in Santa Barbara, Calif. From **Jack Camp** in Mexico City, after a brief stay in the hospital: "I am making an effort to keep up my old army calisthenics," to avoid any future physical difficulties.

Charlie Reed wrote: "Mil and I drove to Corpus Christie for her son Carr's wedding on November 20. I was the Best Man and my son, Bill, sang 'The Greatest of these is Love.' We were pleased to receive the picture of the 60th Reunion Group. How we wished that we could have joined you for that very special occasion." . . . Had nice holiday greeting cards from Beatrice and **Walt Binger** and **Nat Warshaw**.

Don Webster, **Hank Smith**, **Nat Warshaw** and **Joe Connolly** wrote expressing their sorrow on our loss of **Harold Dodge**. Grace Dodge wrote expressing her appreciation to all of Harold's classmates who have sent her their condolences. **Elsa Mueser** was among those who attended Harold's funeral. Elsa writes: "I have a grandson at M.I.T. in his junior year, a very exceptional student, who attends Harvard, Wellesley, and home school — some difference from the old days."

We are sorry to report that Gretchen Gore passed away on January 3, 1977. **John Gore** notified us shortly thereafter and enclosed a copy of a tribute that he composed and was read at the funeral capsulizing her qualities and their joys of sharing 55 years. We'll remember Gretchen as an understanding, joyous and courageous woman who always added a special quality by her regular attendance at our reunions. Because of her afflictions she was severely handicapped in recent years. Her last reunion with us was our 59th. So that she might attend and not be a hardship to any of us, for three months prior to the reunion she practiced walking, with a newly acquired walker, a similar distance and terrain as that from Cottage G to the dining room at Chatham. Yes, we'll remember her and her delightful hats. John wrote: "We were sorry not to be at our 60th. We certainly missed not seeing all you folks"

Somewhat belatedly we received word that **Kenneth Odiorne** died in 1972, and that **Carl Whitaker** passed away on August 26, 1974. . . . **Henry Shepard** sent us the notice of the death of **Ed Barry** on December 31, 1976. It read in part: "He earned three degrees in 1916, A.B. and B.S. from Harvard and B.S. from M.I.T. In World War I, he was an ensign in the Navy's Bureau of Ordnance and was co-inventor of a bomb sight and a bombing training device. He wrote a pamphlet, "Diamond System of Three Cushion Billiards" and a book *Introduction to Geometrical Transformations.* He retired from Stone and Webster Engineering Corp. in 1959, was a former chairman of the State Board of Registry of Professional Engineers and Land Surveyors, and was a fellow of the American Society of Mechanical Engineers."

Our sincere sympathy goes out to all of the families and friends of our departed classmates. Looking ahead, we have made our usual reservations for another annual reunion at Chatham Bars Inn. The dates are June 7, 8, 9, 1977. Technology Day at M.I.T. is on June 10, 1977. Each year we consider dropping the Annual Reunions and limiting ours to the five-year intervals. However, at least 20 of our classmates want us to keep scheduling them, so here we go again. It sure is fun while we last. Hope to see you in June. Keep your letters coming. — **Ralph A. Fletcher**, Acting Secretary, P.O. Box 71, West Chelmsford, Mass.

17

By now you have received the 60th Reunion News with all the details for what appears to be a record-breaking affair. The return cards from our 59th Reunion had 45 men indicating their hope to attend the 60th. **John Holton** writes that he hopes "to have our son Robert, '57, and his wife with us attending his 20th reunion. Both of us were course X and both had Doc Lewis as one of our Professors." **Harold Neumann** plans to attend our 60th with his son Gordon, '42, and his wife who will take in his 35th.

At the time of the M.I.T. Corporation meeting last October, a luncheon was held for past presidents of the Alumni Association. Among those honored were **Ray Stevens** 1944-45, **Ray Blanchard** 1947-48, and **Al Lunn**, 1950-51. On display was a plaque on which were inscribed the names and years of service for each of the past presidents. This will be a permanent feature of the new, developing alumni headquarters in Building 10. Unfortunately Ray Blanchard could not attend.

Don Severance took pictures of Helen and **Jack Wood** last October on the reunion boat ride. Upon receiving them, Jack wrote, "A dull day helped soften the shadows and erase the wrinkles so both of us felt younger than we know we are when we look at the pictures. We look back on the weeks we spent at Cambridge with fond memories and the *Review* article of the dedication came as a real surprise, that so many pictures and space were devoted to it. Perhaps it will help other friends by showing how much fun it is to participate in support of Institute projects. It was fun for all the sailors and it showed even in the down-pour."

Numerous seasonal greetings from classmates were good to receive. Among them was an interesting report from **Howard Melvin** covering his attendance at the December special meeting of the M.I.T. Club of Northern California. Edward Vetter, President of the Alumni Association, spoke. Howard, the oldest graduate present and in his 1917 red jacket, found the speaker and meeting very worthwhile. **Al Moody** is busy and well keeping track of his five children and 12 grandchildren.

The *Bath County Recorder*, Virginia, states, "**Dean E.** (Penn) **P. Brooks** has recently returned from a trip to Japan, Taiwan and Hong Kong. While in Taiwan, Mr. Brooks saw friends and colleagues of his days in China in 1945. His party had a two-hour audience with the president of the Republic of China, C.K. Yen. The men were one-time associates on the Chinese War Production Board. On their return trip they spent a few days in the Hawaiian Islands." Getting back, Penn found all well on the farm with some 30 calves to date and more expected. The natives don't remember such a cold winter. He was to go to Sanibel Island, Florida, to return in March.

After many years of living in Wellesley, Helen and **Stan Lane** have moved to Bradford, N.H. With their winterized home there on Blaisdale Lake, more room was needed for the over-flow from Wellesley, so a new lakeside building for organ, grand piano, pool table, etc. has been built. Ray Blanchard moved from Exeter, N.H., and is now at the Elmhurst Nursing Home, 743 Main St., Melrose, Mass 02176. — **Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

18

Our third session of the M.I.T. Alumni Seminar series explored the M.I.T. contribution to solving the problems of government. Under the leadership of Professor Martha Weinberg of the M.I.T. Department of Political Science we probed some of the difficulties of being governed with diverse groups seeking special treatment at the expense of the whole population. We were interested to learn that M.I.T. students from her classes serve as interns in city, state, or federal government agencies. We can take pride in the work being done by our younger faculty and students in research and expertise on social problems confronting all of us.

I will include a few more greetings now — others will be published in succeeding issues of

these notes. Dr. **Arthur Williams** writes, "At 82 I have slowed down some, but still work too hard with my hobbies — farming (25 acres), growing alfalfa for my friends to feed their horses. I still do all the work myself except hauling in the hay. Also spend much time with my favorite hobby — racing pigeons. Have some fine ones and manage to win some races. Perhaps you knew Morris Gordon ('22) of Boston. His hobby also was racing pigeons. He passed on a few years ago.". . . **Henry Stephens** has much news to report. "My life here at Waikiki for the past four-and-a-half years has been delightful if uneventful. Paul Bragg (age 94) started an exercise class next to the beach at Ft. DeRussy four years ago and I direct and lead it when he is absent in California making TV pictures. We have 50 to 80 people daily for one-and-a-half hours of exercise, 15 minutes of group songs and a 15-minute lecture on nutrition. Other than this I conduct a radio program each Thursday 'Healthfully Speaking.' Judith and I take two long ocean swims daily — one early in the morning, one late in the afternoon. Other than this we visit with friends, attend lectures, concerts, shows, and keep house. We are both enjoying excellent health and good spirits, so what more could one ask?"

Ernest Giles contributes as follows: "I hear from **Robert T. Gidley** about once a year and I hear that he has so many grandchildren that now he is making a good start on great-grandchildren. However I don't think he can beat me because my second son (I have three) married a young red-headed widow who has four young married daughters who are all in the middle of raising big families. I only have one real grandchild, a boy, but another one will be launched soon. The keel has already been laid. The father of my real great-grandson was in the Royal Canadian Air Force in the second world war and he and I were on foreign active duty seven months before Pearl Harbor. He was a pilot officer and I was a major in the Ordinance Department."

Tom Knowland is facing 1977 with much optimism seasoned with a trace element of concern for genus Americanus. . . . Marion and **Herb McNary** spent their fourth Thanksgiving in Bermuda. He planned to slow down but is caught up in increasing activity in legislation designed to save money on auto insurance. . . . **Herb Polleys** included a newspaper clipping describing the late **Carl Blanchard** and how he started his band in the Glenn Miller tradition.

Additional greeting were received from the **Sumner Wileys**, the **Harold Webers**, **B.F. Jones**, and **Richard Rimbach**. A note from Mary Mooney states that her father, **Bill Lutz**, is now 83 and in good health (enjoying the warm California winter weather and playing a lot of bingo.) There was also a most cordial and warm note form **Frances Kelley** with a notice previously reported of the passing of her Joseph. (He had been a vice president of Cities Service Oil Co. for many years.)

My card to **Wendell Monroe** was acknowledged by his wife, Evelyn, with the sad news that Monroe passed away last March of a heart attack. We are indebted to her for a biography of his distinguished career. In addition to his work as a consulting engineer with many different firms, and work in the design of Chicago's subways and the Los Angeles Transit System, Wendall was a member of the American Institute of Electrical Engineers and the American Transit Association. Evelyn adds, "We were married in 1931 and have two sons, Edwin and William."

We report with sadness the death of **Harry C. LaVine**. He was an unusually active member of the class and the head of the Florida Educational Council. — **Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass 02146; **Leonard Levine**, Assistant Secretary, 534 Washington St., Brookline, Mass. 02146

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Ben Bristol reports that his wife Lida died last August, "which is hard to take except knowing that she is no longer suffering. I fortunately have been very busy with a little plus and minus golf. I see C. C. Fuller, '18, regularly and expect to catch up on my fishing in 1977.". . . A Christmas card from **Royden L. Burbank:** "Congratulations for the fine assembly of the many '19 notes in the October/November *Technology Review*. There is much for us in the class of '19 to reminisce about."

Everett F. Doten sent his Christmas and New Year's greetings with these notes: "Here we are at just midpoint between reunions. One of our good friends here in Detroit attended his 50th at Chatham Bars Inn and reports still going strong. So will look forward to 1979.". . . Christmas greetings were received from William P. Fisher, '18, and Julian Howe, '18, and **Will Langille**, our Reunion Chairman. **Ed Moody** sent a very original holiday card from Nashua, N.H.

Albert Mayer writes, "I've been carrying around your courteous request for news, not wanting to disregard it, but with really nothing to say. Actually I entered the class of 1919 as a Junior, and didn't become closely intimate with my classmates. Hence the usual gossipy-friendly information carrying on from a previous point doesn't apply. If anyone is really curious, he or she could consult *Who's Who*." Our "25 Years After" states Albert was a Major in the U.S. Army in 1944, and more recently Architect and Planner of Environments, 31 Union Sq., New York.

Mrs. Lea G. Marshall informed us of the death of her husband Colonel **Harold F. Marshall** on November 22, 1976. He was 80 years old. . . . Arthur J. Mackay reported that his brother **W. Roy Mackay** died on April 12, 1976.

Carl W. Phelps writes "Most of my year has been away from the U.S. in Ceylon and S. India. I am now enjoying retirement in Claremont, Calif." . . . **H. M. Putnam** from Medford, Mass., says, "In 1960 I retired from Bethlehem Steel Co.'s Boston office after 35 years in the Building Products Division. I married in 1919 and have three daughters, six grandchildren and four great-grandchildren."

James W. Reis writes on his Christmas card from Los Angeles, "I am still traveling but now on account of my eyes I am limited to cruises or escorted tours with my sister. This summer I went down through the Panama Canal again to the Caribbean and up in Canada for a little black bass fishing at my old fishing camp at San Sonci on Georgia Bay. In late spring I am going with my sister back to the Far East — Hakaido, North Island of Japan, then Korea and Burma ending up in Bali. I may have to return via Singapore and Hong Kong."

From Lehigh Valley, Penn., **Edward Adams Richardson** reports, "My only brother George died at 90 in 1976 and I became 79. Emphysema gets worse so there is little to report. I scarcely leave the house because of too much smoking for 50 years. It seems hard to give it up but once done it is easy.". . . **Walter C. Roberts** writes, "I am retired after 40 years with Holliston Mills of Kingsport, Tenn., though I worked for them when their main office was based in Norwood, Mass. I have raised seven children (three are now teachers), and I lost my eldest son in France in World War II, awarded silver star. My oldest brother, Class 1912 at Harvard Medical, died five years ago and my other brother, M.I.T. class of 1917, died last year."

Morton A. Smith writes from Great Barrington, Mass., "Nothing new to report. I am still living here alone in the same house where I have been for over 50 years. I keep busy with church, Masonic and radio service activites." Morton owns a radio shop in Great Barrington. **James Strobridge** sent greetings for the holidays from his home in Heritage Village, Southbury, Conn. . . . **Phil R. Thompson** writes, "I am living a carefree retired life (15 years now) and celebrated our 50th wedding anniversary this year. How lucky I am to be alive and fairly healthy! Good luck to all of the class."

From Baltimore, Md., **Francis Weiskittel** sends New Year's greetings and writes, "I sent a memo recently to Cambridge which you will probably receive shortly. My past year has been uneventful as far as our own activities, but I'm proud to announce that I became a grandfather of a girl born July 6, 1976 in Fairfax, Va., my first, and named Laura Elizabeth Kelly."

Last but not least, our President **Donald Way** writes on his holiday card, "Time seems to go faster and faster each year. Barbara and I have enjoyed reasonably good health since we last saw you and hope you and Twink have also. **Bill Langille** has phoned about starting the 60th planning shortly. We send you our warmest regards." — **Eugene R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla. 33444

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Holiday greetings from classmates not have been mentioned in last month's news were received from Denise and **K. B. White**, Florence and **Lee Thomas**, Marge and **Stan Reynolds** and Winnie and **Frank Badger**. Frank promises to be on hand for Alumni Day next June, good news indeed. **Levon Eksergian** writes from Sugar Tree Farm, Stillwater, Penn., "I never know whether to regard my class as '20 or '21. Though I graduated in 1921, most of my colleagues were in the 1920 group." A fellow cellist of the musical clubs and Tech Show at M.I.T., but infinitely superior in musical talent, Levon and I shared many happy experiences. He writes, "I seem to remember following you riding a motorcycle with your cello strapped on your back. I was unable to conclude whether the relatively high moment of inertia of the cello aided or abetted your balance which was manifest in a rather widely divergent sway." Shall I ever forget that ride! It was to attend a musical club concert at Lynn and a wonder I ever survived. Them were the days, and it is heartwarming to share that dim, distant recollection with that renowned cellist, Levon. Levon lives "on top of a hill encircled by mountains — dirt road, no neighbors, no noise, no traffic, but lots of clean air and pure water." Sounds like an ecologist's dream. A letter like that makes a secretary's toils worth the effort.

Word has just been received of the death of **Chris Duffy** of 4215 Jenifer St. N.W., Chevy Chase, Md., on June 26, 1976. Those who attended our 50th will remember Chris who came up from Washington to take in his first class reunion and who appeared to enjoy the occasion. We well remember what a pleasure it was to see him after all those years. — **Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

Well, the Christmas season is behind us and here it is a bitter cold day in January with the thermometer at 10° this morning, snow and ice on the ground and a fine day to sit by the radiator.

Betty and I send thanks to all those who sent us Christmas greetings and particularly to those who added newsy notes. My college roommate **Hobart Fischer** (affiliated with both '21 and '22) wrote that they spent a month in New Hampshire this past summer visiting his daughter and her family. Both Hobart and his wife Gladys were briefly hospitalized last spring but report, "feeling fine now."

The annual Christmas letter from Ceil and **Frank Huggins** had some delightful sketches of Ceil's — one being a Christmas tree decorated with seashells picked up on their South Carolina coast. The Huggins' drove to New Jersey to celebrate Thanksgiving with their daughter and family and returned via some out-of-the-way places they had read about but never investigated. Their family interest this past year was Guinea fowl. "Our experience with them was comical but with sad complications. We now have no Guineas but enough material to write a book. They prefer to roost in trees and are better watch dogs than dogs." Their natural enemies are opossums and dogs who kill just for the sake of killing.

Betty and **Dugald Jackson** wrote, " '76 has flown by as if on bird's wings, with family visits, the Tall Ships, and a number of things, topped off with advent of our first great-grandchild, John Webster Seabury III.". . . **Irving Jakobson** was

planning some sailing in the Bahamas during February. Elma and **John Mattson**'s Christmas letter was another one, complete with sketches. (Who is the artist?) It sounded like an active year for them: gardening, gadgeteering, Bicentennial activities, a Swiss float with Mattson, goats and girls, a painting display, seeing Tall Ships at Newport, touring New Hampshire and Maine with John 'tootling on his euphomium into the clouds.

Bob Miller came through with another fine family photographic Christmas card showing three generations. Bob wrote that they were blessed with three new grandchildren in 1976, bringing their total to 14. Vivian and **Leo Pelkus** wrote that they would spend part of the winter at Key Biscayne, Fla. Dorothy (Mrs. **Joseph**) **Wenick** vacationed during December in the British Virgin Islands, with her sons Dick and Martin. The latter is First Secretary at the American Embassy in Rome. Dorothy planned to spend February in Warm Mineral Springs, Fla.

MIT conferred Corporate Leadership Awards on December 3 to 152 alumni who are chairmen, presidents or managing partners of many leading business organizations in the United States. Among those receiving awards was Assistant Secretary **Samuel Lunden**. Congratulations, Sam!

Garvin (Mich) Bawden, Class President during our Junior Year at M.I.T., died on December 22, 1976 at Plymouth, Mass. He and his wife Helen have lived in Naples, Fla., for some years but spent their summers in Duxbury, Mass. Mich was captain of the track team in our Senior year and set several collegiate records. After graduation, he worked for two years at Stanley Boston Co., manufacturer of Stanley steamers. Subsequently, he worked for Miehle Goss Dexter (printing machinery) from which he retired in 1962 as New England Sales Manager. Over the years, Mich attended most of our reunions. Our condolences are extended to the family. — **Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Clr., Sarasota, Fla. 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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Our Classmates in Florida may not realize how beautiful Buffalo looked during the Christmas season with extremely low temperatures and lots of snow. This is a good time to visit your Secretary — in lieu of which — PLEASE WRITE NEWS.

Our colored holiday card from Catherine and **Mac McCurdy** shows the lovely couple aboard the *Blue Peter* on a waterway near Seattle. They look young, active and extemely healthy. They will see us as they celebrate their 55th wedding anniversary in Cambridge after spending the winter at Indian Wells, Calif. . . . Greetings from Buck and **Peter Eacker** shows a snow view with street cars along the Common. At least our street cars are gone. . . . Madeline and **Parke Appel** prefer staying in Venice, Fla. So we hope to stop in on our way down in January to pick up that shovel he promised.

Parke report the latest word for the 55th: he has a confirmation from 20 couples and five singles on both the Campus and Spalding, plus five couples at Spalding only and five couples on Campus only. We will assemble on Campus and be housed at the McCormick House from Wednesday, June 8 until Sunday morning, June 12. Then we will travel over the road to Spalding Inn at Whitefield, N.H., and celebrate from Sunday afternoon, June 12 until Wednesday noon, June 15. The details include Class cocktails and special dinners with entertainment every night. Our Classes will take us to the Pops Concert on Thursday night. The Alumni Luncheon on Friday noon on Alumni Day will be during the regular program. Don't miss Saturday's North Shore talk and luncheon followed by a special Saturday Night Party. The three days at Spalding Inn for fun and frolick sound great. Don't Miss It!

Dwight F. Johns of Oakland, Calif., attended a 60-year reunion of his Military Academy Class (1916) at West Point in May of '76. . . . **Samuel I. Zack** of Hollywood, Fla., reports he has recovered from major surgery and is back to normal activities which includes golf several times a week. . . . **Lachlan MacKenzie** of Sun City, Calif., is preparing a genealogy of Clan MacKenzie of Kintail. He has visited the home territory of the Clan in Ross-Shire, Scotland.

Ray C. Burrus of Hallandale, Fla., has been named by the Hallandale City Commission in November, 1976, to serve on the Central Planning Committee of the South Campus of the Broward Community College. Ray helped develop the "stretch-out" financing program which allowed the city and the Broward County School Board to bring a high school to Hallandale. . . . **John W. Strieder** of Newton Lower Falls, Mass., will be visiting Professor of Thoracic Surgery at the University of Pennsylvania during January.

We were shocked to receive a page from the *Boston Herald American* in December telling of the sudden death of **Roscoe Sherbrooke**. He leaves his wife, Virginia, and a son, Ross, of Dedham. Do you remember Roscoe at our fifth Reunion guiding the cars into the big hotel grounds at Falmouth, his entertainment with clues, and diving for the buried treasure along the shore? . . . We also send our sympathy to the families of **Irving Whitehouse** of Cleveland, Ohio, and **Paul N. Hillard** of Clearwater, Fla.

As your Secretary and Dorothy sit beside the ocean in the sun at Pompano Beach, the snow in Buffalo seems more beautiful — and far away. — **Whitworth Ferguson**, Secretary, 333 Ellicott St, Buffalo, N.Y. 14230; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

23

Tommy Rounds and his wife, Marjorie, are on a trip to California and points west. He has asked me to pinch hit for him during his absence. I can't hit homeruns for him but I don't mind trying to bunt.

I write this in the middle of winter. The snow, lining our driveway, is three feet high. The skating rink in my back yard is smooth as glass. It is small and makes me cut eights in order to stay on it, but the exercise and the fresh air are both great.

Sam Williams writes from his home in New Hampshire: "I recall in my early days everyone was glad to see the snow, and the more the better. That was when wheeled things were put away and every thing moved on runners. The roads were rolled instead of plowed. The biggest bother was drawing the snow into the covered bridges. We could slide on the roads and hitch on to a passing sleigh to get up the next hill."

In a Christmas letter from **Arthur Stuckey** in Tucson, Ariz., he reports that the condition of his wife, Helen, has greatly improved since her relapse last March, and they look forward with pleasure to each succeeding day, although their range of activities is still limited. They drove 100 miles to attend an anniversary lunch at the Tubac Country Club. And, they visited the Kitt Peak Observatory.

The Stuckeys deserve special commendation from our class because during 1976 they didn't miss church a single Sunday. (Can any of you readers match that?) Their favorite T.V. programs are sports, politics, documentaries, and educational offerings. (What's wrong, Art, with the Tournament of Roses Parade?)

Lyman L. Tremaine has the unique reputation of becoming a great-grandfather before becoming a grandfather. His lovely wife, Helen, was a great-grandmother in her own right. Then Lem's son, Russell (and Melinda) had a son, Scott Russell Tremaine, born just before Thanksgiving. On Christmas, Lem took the three of them to the Ritz because Scotty wanted to have his first Christmas dinner there.

Lem shows how well he knows me by writing, "It's too bad, Pete, you don't have any creative talent like music or writing. You're just so stereotyped and run of the mill that you could never think of composing any Tech songs or writing or editing any manuscripts or doing anything out of the ordinary. But, as they say, you can't teach an old dog new tricks, so I guess there's no hope for you."

Lem's comments were inspired by an excerpt from my newest creation, *The Vanderloon Twins*, obtainable at $4.95 from the Carlton Press Inc., 84 Fifth Ave., New York, N.Y. 10011. This autobiographical tale of the fun and adventures of a pair of unpredictable twins is guaranteed to carry your minds far away from the downpour of crimes, dishonesty, frustrations, investigations, cover-ups, energy shortages, depressions, recessions, unemployment, mounting national debt, political transitions, and countless troubles reported daily by the news media. If you wish to escape from all this, if you long for the good old days when life, liberty and the pursuit of happiness prevailed, then *The Vanderloon Twins* will claim a special place in your affections.

Walter N. Webster, Chairman of the Board of H.K. Webster Company, Inc., Lawrence, Mass., received the M.I.T. Corporate Award for Leadership. This award is given to chairmen, vice chairmen, presidents or managing partners of leading U.S. industrial organizations.

Ida M. and **Cecil H. Green** were principal donors to the Cecil H. and Ida M. Green Hospital, recently erected just north or San Diego, Calif. A portrait of them was unveiled in the lobby of the facility. For years Cecil Green has been a trustee of the Scripps Clinic and Research Roundation at La Jolla, Calif.

It is with regret that I report the death of **John Jacobs Gray** on May 24, 1976. This belated notice was just received. John was a civil engineer, born in 1901 in New York City, and spent his business career with Ford, Bacon and Davis. In World War II he served in the Engineer Corps of the Navy, as a Lieutenant commander. — **James A. Pennypacker**, Assistant Secretary, Long Hill Rd., Essex, Conn. 06426

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On December 3, 1976, the M.I.T. Corporation awarded silver bowls for "Distinguished Corporate Leadership," recognizing the extraordinary achievments of Alumni in business and industry, serving the public and nation by innovative, exemplary conduct and private enterprise. The two oldest awardees were **Herbert W. Kochs**, Chairman of The Diversey Corp., Chicago, and **David A. Meeker**, Chairman of Hobart Corp., Troy, Ohio. Herb is a substantial shareholder in his company, incorporated in 1923 and reincorporated in 1970. Diversey produces industrial cleaning compounds, organic and inorganic chemicals, and electronic solution controls. Dave, an active classmate, spent some time with General Motors Research Corp., and joined Hobart in charge of engineering, and became president in 1949. Hobart is a leading manufacturer of machines for preparation, sale and serving of food. Your scribe assumed that Dave donated the electric stove as a door prize at our 35th, but Chick Kane's report indicates that **Walter Weeks** was the donor. Maybe Dave can find a refrigerator for our 55th.

Robert L. Morton writes from Pensacola, Fla.: "Mrs. (Betty) Morton and I throughly enjoyed last March meeting at Sarasota Hyatt House of the Florida residents of the Class of '24. We hope to see more of the bunch the coming year. I had a collapsed lung October 22, but it was easily fixed without major surgery — just the insertion of a tube to drain the air out of the lung cavity. I'm told that they cannot tell why this happens in the first place". . . .**Eugene L. Quirin** writes: "Etiennette and I have changed our domicile, and address, to: Village Spires North 702, 3554 Ocean Drive, Vero Beach, Fla. 32960. Now a neighbor of **John Fitch**, in a complete reversal of a vow never to leave good old Boston." . . . From **Blanchard D. Warren** in Portland, Ore.: "Spent most of August in hospital for surgery. Am fine again! My five children are married and made me a grandpa 11 times so far." . . . From **Paul Cardinal**, Naples,

Fla.: "Composed enclosed poem for **Pret Littlefield**'s 75th birthday and read it at a cocktail party for him. We are looking forward to '24s fourth Florida Fiesta in Fort Lauderdale next week." The poem, titled "The Scribe of Harbour Drive," extols Pret's capabilities as fisherman, card shark, financial wizard, poet and drink mixer.

Thomas P. Coogan died December 3, 1976, in Bal Harbor, Fla. He was in Course VI, electrical engineering, and in 1967 was president of Housing Securities, Inc., New York City. He will be remembered as our host for the 35th cocktail party in his mansion adjacent to the Oyster Harbors Club. . . . **T. Thornton Oxnard** passed away November 29, 1976 in Los Angeles. He joined us for two years in Metallurgy and Materials Science and received his B.A. and M.A. from Rutgers and Harvard. The operator of Airport Flying School at Amarillo, he was a pilot in the U.S. Air Force from 1942 to 1945 and a Major, as chief check pilot for the "Fireball" transatlantic run.

On a happier note, Class president **Frank Shaw** rounded up a group of eskimos for a luncheon January 22, attended by Hazel and **George Glennie**, Dot and **Ray Lehrer**, Barbara and **Frank Shaw**, Winnie and **Herb Stewart**, Nellie and **Hoyt Hottel**, **Don Moore**, **Ed Moll**, **Ted Burkholder** and **Russ Ambach**. Chief topic of discussion was a Reunion supplementing Technology Day, June 10. **Ed Moll**, 55th Chairman, is planning a pilot reunion at Old Sturbridge Village, Sturbridge, Mass. He is a Director and deeply involved in the successful operation of this authentic project. You should have received a questionnaire, a suggested agenda and cost estimate. The purpose is to make the trip to Cambridge more interesting and productive through factual reminders of the ingenuity of our New England settlers. — **Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146; **Herbert R. Stewart**, co-Secretary, 8 Pilgrim Rd., Waban, Mass. 02168

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Christmas Greetings were received from **George Blonsky**, **Chink Drew**, **Fred Greer**, **Hal Halliburton**, **Kammy Kametani**, **Sam Spiker**, and **George Washington**, and I wish to acknowledge them with thanks. Also, greetings cards were received from the widows of **Tony Lauria**, **Ave Stanton** and **Irving Symonds**.

On December 3, 1976, as has been reported elsewhere in the *Review*, M.I.T. Corporate Leadership Awards were made to 152 industrial leaders. Included in this honored group was our classmate **James S. McDonnell, Jr.** In recognition of his 50 years as a member of the American Institute of Mining Engineers, **George** (Count) **Blonsky** has been made a Legion of Honor Member of the Society.

A note from **Russell Grove** states that he is still a lawyer but with the 1976 tax laws he feels more like a freshman than a 1925 senior.

The M.I.T. Club of Cape Cod was officially organized on December 8, 1976, at a meeting attended by 63 alumni including four 1925 classmates: **Paul Goble**, **Will Mahoney**, **Ken Proctor** and yours truly. Officers were elected and I was asked to handle the club's funds as the Secretary-Treasurer during the first few months.

It is with sorrow that I report the passing of **Dow Drukker** on November 18, 1976, at his home in Palm Beach, Florida. — **F. Leroy (Doc) Foster**, Secretary, 35 Woodland Way, P.O. Box 331, North Chatham, Mass. 02650

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It seems more fitting for a Pigeon Cove locale to say that your class secretary is eating seagull even though you will understand "eating crow" more easily. In the February issue we ecstacized about the climate and the beauty of winter. We chided our classmates in Florida, Puerto Rico, Arizona, Texas and California and pointed out that they could not put their trays on the porch and have ice cubes in an hour. Please forget everything I said. The same conditions that froze the ice cubes have frozen the pipes in our guest house. The bill for plowing our driveway so far would pay for a round trip to Florida. From where you are you must hear about the deep freeze New England has been experiencing for a month. Please write me and tell me how nice it is where you are!

Elton Staples *has* (from Orlando) and here are some excerpts from his letter: "Thank you for your note of November 21 and the good news that Ruth was progressing well from her hip replacement. This seems to be a common repair these days. Our neighbor had the replacement and is playing golf again. I hope Ruth's result will be as good so George doesn't need to continue as cook, housekepper and chamber maid! That's now my routine! It has been a good winter so far, the coldest day, 32° here, this morning, but usually 50-60, and sunny. I am writing before a cheery fire — on my knee-desk.

"Our three sons and families were all here over Christmas — 15 of us now, and we had a great reunion, Although the main spirit was with Miriam, her presence was sorely missed. She was a true inspiration to us all. Our 29th annual camellia show was last week and we had a great exhibition of blooms and attendence. Now tomorrow I talk to the Garden and Nature Group of the University Club on Camellias. We miss **Ray Mancha** deeply. He was greatly loved and admired and a strong supporter of the Club. Isabel is getting on well, and says she will write to you soon. Regards and best wishes to all."

John Longyear has written from Dearbon, Mich., (in addition to his usual Christmas Card of spices they raise) and sent along **Alex Brown**'s address since Alex was listed in our reunion directory as one of our lost sheep. It is Alexander H. Brown, 110-B Lowell Ln., Rossmoor, Jamesburg, N.J. 08831. Alex and his wife of course did make the reunion and have been removed from the "lost" list. If any of you can tell us the location of other classmates on the lost list, please do. I wrote **Bob Glidden** at Camden, Maine, where he is supposed to live but had no reply, nor did the letter come back. The Class Directory which was sent to all classmates for whom we had an address, just prior to our 50th reunion, is the most useful reference a class secretary could possibly have other than our "Technique." I'm sure that you find it useful as well. I will deeply appreciate having you help keep it up to date by writing about any changes of address, locations of "lost sheep" as they are classified in the directory, etc. And if there is any classmate you want to know about, write us and we will try to get the answer. We are real interested in knowing more about your own activities and about the attractions of your area. I ran out of steam about Pigeon Cove when this deep freeze set in, but have just become a member of a small new swimming club that has a delightful pool with the entire south wall of glass which looks out over the fields and plenty of deck chairs. So as soon as I say cherrio I'll be on my way to take a quick dip and bask in the sun before lunch (it's only a mile away).

One more important news item about two classmates. **Thornton W. "Mooney" Owen** as Chairman of the Perpetual Federal Savings and Loan Association in Washington, D.C., and **William C. MacInnes**, Chairman of Tampa (Florida) Electric Co. were among 152 Corporate Leaders honored on December 3 by the M.I.T. Corporation at the Waldorf Astoria in New York. Congratulations "Mooney" and Bill for this Leadership award. Now Cherrio and off to the swim. — **George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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As of mid-December, 1976, **Bud Fisher** reported gifts and pledges to the 50th Reunion Gift of $426,000, or just over three-fourths of the goal of $550,000. The rest will have to come in before June if we are to fulfill the goal.

A few of us, meeting in New York in mid-January, heard an interesting discussion by Hugh Darden, Institute Secretary, on the tax advantages of contributing through a Life Income Trust, rather than by testamentary gift. As little as $5,000 can be put into the pooled fund ($50,000 for unit trusts), with credit for the full amount to the class gift. Gifts of appreciated securities provide the biggest tax savings. Details are available from the office of the Institute Secretary at M.I.T. — or write to Bud Fisher at Duxbury, Mass. 02332, or to any other member of the reunion gift committee.

Johnny Driskо is now working four days a week at Tibbets, Abbott, writing the completion report on the huge dam in Pakistan to which he has devoted many years. He hopes to finish by this summer, and then retire. . . . **Ray Hibbert** has sold out his business in plastic materials, but he still represents a plastic-forming machinery company, and has taken a partner to lighten the work load. He says business is booming. Ray has kept in touch with **Jim Lyles**, and says that Jim continues to add to his collection of antique woodworking tools, despite his limited mobility. Between the tool collection, railroad memorabilia (including a locomotive bell), and other antiques, Jim and Molly have a very extensive museum at their home in Canaan, Conn. . . . **Dick Cheney**'s Christmas greeting says he is "master-minding" what may be America's first successful, economically viable, city-wide "source separation" resource-recovery program, in Downey, Calif. He is also now First Reader in the local Christian Science Church.

Ken Smith writes: "Currently taking a delayed sabbatical traveling in Europe and the Near East. Made one trip to Persian Gulf in August for an architectural judgment. Present plans call for going as far as Ispahan and then back to the U. K. in the spring." . . . **Ted Ordman** is still active in patent law, but is beginning to think of retiring, with winters in Montego Bay, Jamaica, (where his wife owns a home) and summers in Ducchess County, where they have a summer home. . . . **Herb Johnson** is busy consulting on the set-up of a new local steel and stainless forging plant with all-electric billet heating and pressing, to conform to E.P.A. standards on noise and pollution.

Harland Sisk is active in the Cape Cod chapter of S.C.O.R.E., and is currently chairman of its education committee. He has also been treasurer of the Needy Fund for the past nine years, and has taken up oil painting. . . . **Mark Robbins** keeps rebuilding old cars and following the auto races. He has had a bout with surgery, but is rapidly getting back into shape. . . . **Elwood Church** took an extended trip last summer through New England, Canada, and on into the U.S. Midwest and Far West, including a white water raft trip down the Chilco, Chilcotin, and Fraser Rivers in British Columbia. He expects to repeat part of the trip this coming summer (after attending our 50th Reunion), and to include Alaska. Elwood lost his wife, Florence, last February and, understandably, still finds the adjustment difficult.

Louis F. Eaton, retired president of Brockton Edison Co., died in December at his home in Duxbury. Eaton was a 1915 graduate of Amherst and served as a communications officer on the *U.S.S. Arizona* during World War I, prior to joining our class at M.I.T. He was 84 at the time of his death. . . . **Frank Stubbings** died on Christmas Eve in Holiday, Fla., where he had lived for seven years. He had been manager of a textile plant in Quebec before retiring. He is survived by his wife, Edna, and by a son and daughter. . . . **Albert Kauzmann**, who had been a senior engineer with RCA Corp., died in March, 1976, in Milburn, N.J.; I have no details.

We spent the holidays in Atlanta with my grandchildren (and their parents), and they were complaining of the cold spell in Atlanta, with nighttime temperatures getting down to 20°. — **Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

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We have a very welcome letter from **Allan Tarr**. With a busy life of many and varied experiences

to look back upon, Allan is now engaged in real estate activities, as a notary public in Virginia and in security services. Following graduation from M.I.T., Allan became an assistant in the Institute's Department of Mining and Metallurgy, then did graduate work at Columbia University for his M.S. degree. His campaign literature (when he ran for town council in Marion, Va.) discloses a great breadth of interests and capabilities. These include the field of education (10,000 past students), industrial research, and military service. Allan is widowed but keeps busy with music, languages, locks, and overhauling pianos as hobbies — all this in addition to his business. He would be pleased to hear from other '28ers: P.O. Box 521, Marion, Va. 24354.

In a note to **Jim Donovan**, **Bob Larson** expresses the wish that more alumni support be given to M.I.T. involvement in projects related to the private sector as opposed to Institute research under government direction and control. Bob and Kay are looking forward to the 50th and have a date for that occasion with **Ben Kelsey** and his wife. . . . Again, in a letter to Jim, **Bill Hurst** tells about the seminars he has been giving in problems in reservoir mechanics. Bill is a widely known petroleum engineer with a lifetime of practice and experience.

Max Parshall wrote to us at year's end. Enclosed with the letter was a color photograph of Max and Hunter Rouse, '29, taken in November at Sun City, Ariz. Both gentlemen look very well and content against a background of green lawn and palm trees. Music continues to be a principal interest of the Parshalls. On Christmas Eve they tape-recorded music played by visiting friends. Max has a cello. We can presume that he plays it although he does not say so. He did mention that **Sam Weibel** plays. It makes us wonder how many of our modest classmates have hidden talents!

In our collection of short notes: Peggy and **George Mangurian** spent a week in London last June. In October they went to Europe visiting Paris, Brittany and Rome. While in Rome they visited with son Bob who is at the American Academy. . . . **John Houpis** says that oranges are in season at his citrus farm in Corinth, Greece. He has every intention of making the trip to Cambridge, Mass., next year to be at the big reunion. . . . We are pleased to learn that **George Chatfield** is recovering nicely from his recent operation. . . . **Bob Proctor**'s five children and their families will be gathered on Nantucket Island next July when Bob's younger son will be married. Bob reports that he has recovered from his heart attack of last year and from a gall operation last May. . . . **Jim Rae** says that he is living a peaceful retired life at his seaside community of Sea Girt, N.J.

To Jan, formerly Mrs. **John W. Chamberlain**, we send our best wishes for many years of happiness. On December 29, 1976, Jan was married to Dr. Edward Sawyer, a retired surgeon and one of Jack's friends. They will live in Duxbury, Mass. . . . A note from **Fritz Rutherford** tells us that he is well and busy with civic affairs. He still plays golf, shooting in the high 70s or 80s. Unfortunately, Jo is not well and requires close care and medication. . . . From Fresno, Calif., **Jim Nargis** announces that he is retiring from active practice of architecture and is now emphasizing historical preservation and surveys for environmental impact reports. He is also the architect retained in charge of restoration of historical buildings. All of this keeps him occupied.

We are very sorry to report the deaths of three classmates. **John L. Barnes** died on October 1, 1976. The information was received from his wife, Mabel. After graduation John studied at Princeton University where he received his Ph.D. in mathematics. His life work was mostly as a college professor with interests in electrical and electromechanical engineering.

G. Donald Buckner died on January 5, 1977 as the result of a heart attack. Prior to retirement, Don's professional work was almost wholly in the field of public health. Besides his wife, Ruth, he leaves a daughter, Phyllis.

Henry Moggio died on September 7, 1976. Henry had been retired for two years after managing his own textile business during most of his lifetime. He was much interested and involved in various civic activities up to the time of his death. His wife, Carolyn, and two daughters survive him. To each family we extend our heartfelt sympathy. — **Walter J. Smith**, Secretary, 37 Dix St., Winchester, Mass. 01890

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David H. Wilson is "still active in my business of designing and manufacturing brassieres, but not so many girdles as we used to. To date, I have ten grandchildren, one of whom is a senior at M.I.T., another is a junior at Harvard and a third one is starting her freshman year at Michigan State and wants to be a veterinarian. So far all my grandchildren are well motivated." In designing and fitting brassieres, David uses "line" models. I have a hunch that all this fitting work on models is done under the supervision of his wife Ethel. . . . **Heinn F. Tomfohrde**, who is still working for Union Carbide, was promoted to President of the Chemicals and Plastics Division. **Everett I. Kelly** has just "welcomed aboard" his seventh grandchild and is wondering where it's going to end. "In truth, I'm proud and live in hopes that my three sons do as well with their children as I have done. With cost of education being what it is, and what may become in the future, it may be an impossible goal for each one to achieve." . . . **Hugh G. Hamilton**'s wife has sent me a note which reads, "Hugh was so pleased to receive your thoughtful birthday greetings. He is well, but not as able as last year to make the trip to New Hampshire this summer, so we stayed here in Boca Raton. We are enjoying the easier tempo of 'off season' life. The weather is delightful and with our house being on the Intercoastal Waterways and near the Ocean, we always have the delightful southeast trade winds everyday. Hugh would like to be remembered to all his friends and classmates."

George G. Meyers, Jr.'s note starts, "This past year has been a bit hard to describe. It can be best summed up by saying, 'Hurray' it is over and we are still alive; and all members of the family are healthy and happy." George and his wife Barbara are still very active physically, play tennis two or three times a week despite Barbara's recent surgery, fusing a small piece of her hip to her spine. As a therapy, she is required to walk briskly at least a mile a day. The Meyers are also active in their church (Christ Episcopal), George is on the Vestry, is teaching Sunday School and is chairman of the Education Committee. Barbara has been doing Program Resources for the Diocesan E.C.W. last fall, we had a delightful overnight visit from George and Barbara in Arlington while the latter had a periodic check on her recent operation at Massachusetts General Hospital. . . . **C. Clarke Keely** has remarried a lifetime friend, Martha S. Hodgson after his wife, Beatrice, died in 1974. They live at 100 S. Hudson Place, Los Angeles, Calif., 90004. They would welcome a visit from any '29er who happened to be in that area.

E. Neal Wells is still active in civic affairs. He is a member of the Planning Commission of Pinellas Park, Fla., and president of a 115-member Lions' Club. Neal was with A.T.&T. for many years before his retirement a few years ago. Every summer the Wells come North where their roots are — Helen's in Pennsylvania and Neal's in Massachusetts. We have two sure attenders at our 50th which is a little over two years hence. I received a telephone call from **Jim Fahey**, the General Chairman of our forthcoming 50th Reunion, while he and Ruth were vacationing in Del Ray (Fla.) which is about 20 miles north of us. He would like to have every '29er in all parts of the globe to add his personal effort towards our goal in 1979 for a large attendance. Those who would like to do a little more and would like to become a committee member in his district should write to: **Jim Fahey**, General Chairman, Georgetown Rd., Boxford, Mass.

I would like to express my appreciation for many of you who showed concern for my well being with the absence of 1929 Classnotes in the *Review* for a couple of issues. My apologies for my inability to contribute classnotes for the first time since I assumed my duties as Secretary. I assure you it will not happen again while I am still alive. See you in 1979 at Chatham Bars Inn. — **Karnig S. Dinjian**, Secretary, 6000 N. Ocean Blvd, Apt. 14-E, Ft. Lauderdale, Fla. 33308

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William E. "Cul" Cullinan has had an impressive career in the field of airport administration. He reports that he has retired twice and is now living in Cape Elizabeth, Maine, and doing consulting work on airport services for E. C. Jordan Co. Inc., Architects and Engineers, of Portland. He is President of the Maine Airport Association and Chairman of the Vocational Service Committee of the Portland Rotary Club. Last year he received a visit from his thesis partner, **Emilio MacKinney** of Mexico City, from whom he had not seen or heard since June, 1930. He also has recently seen **Parker Starratt** whom he said is teaching a course in airport management at a "small New Hampshire college," which according to my records is Nathaniel Hawthorne College in Hancock, N.H.

Bob Cook is an associate architect with Bailey and Gardner of Orance, Va., and has maintained his interest in learning and creative environments, devices and systems. At one time Bob was Director of Engineering of Virginia Metal Products, a manufacturer of moveable partitions for commercial and institutional buildings and book stacks for libraries. He has specialized in the last ten years in the design of libraries and learning resource centers. His optimistic forecast is that "the process of learning technically-based disciplines will take a quantum-jump forward in the next ten years," and he hopes to be a participant in that field.

Bob Crowell retired from Armstrong Cork in Lancaster, Penn., in 1972; thereafter he and Marge spent parts of the year in Maine, in Sarasota, Fla., and at their home in Lancaster. It now appears that the Crowells have pretty much settled down in Sarasota. Bob is a member of the M.I.T. Club of Southwest Florida which has a number of luncheon meetings during the winter months with about 35 to 40 attendees and a final get-together at a picnic on Casey Key in April which draws up to 100 alumni and wives.

We have a note at hand that **George Gassett** died on December 3. As many of you know, George worked as an engineer for Stone and Webster for many years and traveled extensively, living in Japan from 1958 to 1962. After retiring from Stone and Webster in 1974, he worked as a consultant for United Engineers and Constructors. You may recall that George was already an accomplished musician when he reached M.I.T. and he maintained his musical interests throughout his life. He was a member of the Hingham Civic Orchestra and of the South Shore Concert Band, with whom he made a number of recordings. He also had a membership in the Local 138 of the Brockton Federation of Musicians, as well as in the Japan Society of Boston and the Fellowship Masonic Lodge of Bridgewater. Reunion regulars will recall that George and Quinby attended numerous class reunions. — **Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, N. Y.

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Dick Baltzer writes that he retired in 1968, ran for Town Clerk in 1970 and has served in that position ever since. He was sorry to miss the 45th Reunion but is looking forward to the 50th in 1981. . . . **Jack Lane** is an associate member of the Independent Oil Compounders Assn. Jack has been very active in the petroleum and automotive industries for many years. . . . Major General **Bob Fleming, Jr.** states "I am inactive." . . . **George Manter** reports that he retired from the New England Telephone Co. in February, 1975. . . . Corporate Leadership Awards have honored **George M. Bunker**, **Dave Bernstein**,

Emilio Collado, **Dick Kropf** and **Herman Ferre**. Congratulations to them all, and also to Dr. **Jim Fisk** on being named to receive the 1976 Hoover Medal. . . .**Addis E. Kocher** says his interests include lapidary, silversmithing, gardening and the local historical society. He also lectures on travel and the history of guns. . . . Ham radio has brought **Fred Eiser** and me together again, much to my delight. His call is KH6CZ and we have a schedule every evening at 5 p.m. our time on 14035 plus or minus. Both of us would be glad to have other ham classmates join us. A clipping from the *Honolulu Advertiser* tells of the death of **Tom Litaker**. According to the article, Tom was well known in Hawaii for his watercolor and acrylic paintings as well as for architecture. Our deepest sympathy to his family. It is with sorrow that we announce the death of our classmate, **Robert McKenzie** on October 27, 1976. — **Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, Fla. 32757; **Ben Steverman**, Assistant Secretary, 260 Morrison Dr., Pittsburgh, Penn. 15216; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, Mass. 02158

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Among the alumni receiving Corporate Leadership Awards at the M.I.T. Corporation luncheon New York City, December 3, 1976, were the following classmates; **Bennett Archambault**, Chairman and President, Stewart-Warner Corporation, Chicago, Ill., **Robert B. Semple**, Chairman, BASF, Wyandotte Corp., Wyandotte, Mich., **Byron E. James**, Chairman, McQuay-Perfex, Inc., Minneapolis, Minn., and **Howard F. Carver**, Chairman, The Gleason Works, Rochester, N.Y.

Rolf Eliassen, Professor Emeritus at Stanford University and Board Chairman of Metcalf and Eddy Engineers in Palo Alto, Calif., has been given honorary membership in the American Society of Civil Engineers, the society's highest honor. Rolf was cited for "his wide-ranging contributions to environmental engineering education, research and consulting practice and for his outstanding service to international, federal and state agencies and governments."

Leo T. Tyburski relates in a pleasant note that he is still working with computors in the New Jersey and Washington, D.C., areas. His daughter Thea is a stewardess for Pan Am and his son, Tom, is a Navy Lieutenant flying out of Adak, Alaska. He has a couple of high flyers in his family. . . . **Joseph C. French** retired to Cape Cod last February and is keeping himself busy remodeling his home, doing most of the work alone. . . . **Richard S. Huested** bemoans the fact that he has to live in California, with M.I.T. closing in, he says. He has two daughters at M.I.T., one a junior and the other an employee, a son-in-law who is an assistant professor, and a nephew-in-law at the Draper Lab. Move East, young man, move East!

Jacob Millman retired from Columbia University faculty in January, 1976, but remains very active technically. He is working on his eighth book on electronics, and is Vice President and member of the board of an optical scanning company, Compuscan, Inc., in Teterboro, N.J. . . . **Edwin H. McCormick** has come out of retirement to run two separate laboratories, one on waste water and the other on drinking water. Having passed the Georgia Certification Examinations, he is now the proud posseser of the Class I operators license for wastewater and the Class II operators license for groundwater.

It is with regret that I report the passing of **Howard F. Atwood** on April 30, 1976. The sympathy of the Class is extended to his family. — **John W. Flatley**, Secretary, Apt. 204, 5100 Dorset Ave., Chevy Chase, Md. 20015

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Again no top billing, as there are too many who have to be considered. Perhaps a great lot of Christmas cards are the top. So here goes.

Dot and **Bill Huston**'s card says that they still recall their pleasant visit with us, in Florida in 1971. Jean and **Fred Aldridge** say that it is nice to have us in Florida; they are Miamians, now. Jean and **Cal Mohr** wish us health and happiness — a welcome message, as long-time-no-hear from them. Prue and **Horace MacKechnie** and Doris and **Len Julian** sent cards with their annual letters — see below. **Clarence Westaway** comes through with a dandy: "Never a Christmas morning, never the old year ends, but somebody thinks of somebody, old days, old times, and old friends." Ellis and **Ralph Cross** (see more below), Louise and **Ellery Clark** (again more later), Katherine and **Carl Swansen**, and — last but never least — the Lucy and **George Henning** card — a montage of some 35 photos of their home and all their travels, which are extensive. I note trips to Ireland and to Santa Barbara, Calif. They show a three-masted schooner; whose is it, Lucy, yours? I noted, at once, a sign "Bellvue" and was relieved to find it was not a hospital but a hotel in Baden Baden, while on a Germany trip. A very effective card, kids, and a heckofa lotta work.

The MacKechnie letter was covered, in part, in an earlier set of notes, so we continue. Horace and Prue went to Cambridge for the first reunion since Radcliffe took over Harvard. I know that Horace is not yet retired, but he seems to find plenty of time for concerts at the Kennedy Center and plays at the Folger Shakespeare Library and lectures at the D.A.R. Hall.

Doris and **Len Julian**'s card was accompanied by their family letter: Doris now working at offset printing, Len has taken up fine cabinet-making and fancy wrought iron work. Len and Doris were in Bermuda last February, then in May to southern Spain, Costa del Sol, and visited many small towns inland and also along the whole coast. This was the tenth trip to Spain, and apparently they love it.

Jack Andrews and Jermain come through with one of their better Christmas letters. Daughter Val was married in March, and daughter Jamie was married in Princeton in September. Jermain had a full school year, plus the wedding preparations, and Jack is still doing transportation for the state of New Jersey and in church work, skating, and tennis.

Most of you may not know that our classmate, **Pete Du Pont III**, has a son, Pete IV, who has been elected Governor of Delaware; from his publicity, he seems to be a stem-winder.

Some little time ago I sent sort of an exploratory note to **Paul Genachte**, who was associated with the Chase Manhattan Bank, Madrid. Paul responded, saying that he had retired from the bank in 1974 and was doing some traveling, his "only" luxury. He had just returned from visiting a daughter in Connecticut, and another daughter lives in Brussels, so they have grandchildren on both sides of the Atlantic. Paul and Suzanne are seriously considering moving back to the U.S., settling in Florida.

Ellery Clark and Louise sent us a fine card with all the spaces filled with messages galore. After a trip of 15,000 miles they were home to California just before the holidays via a one-ton camper hauling an Airstream house trailer. Ellery did not mention all the stops, but he appeared in New England after stopping in Louisville for a convention. . . . A rather fine Christmas letter arrived early, from the **Werner Bachlis**, Lenox, Mass. Werner says that they have few visitors but admits that they do little visiting theselves: "Our life is pretty quiet, and that is why we love it." . . . Now comes a card and letter combined from **Harry Summer**. Harry allows that nothing much happens, then goes on to say that he got tired of the expense of keeping up a very large house and has moved three blocks into a two-bedroom condo apartment, and he is happy. He now is facing imminent retirement and is not happy about that, not a bit.

I want all of you to know how much Leona and I appreciate the cards and Christmas letters, and we wish you to understand that we are totally unable to reciprocate, as 450 cards from us to the faithful might make us a hardship case.

Now a couple of apologies: I know Edna and **Jim Turner** sent us a Christmas card, but I can't find it. Also, Col. **C. T. Newton** sent us a card, mebbe Christmas, that he is very busy fishing off his own dock in Nokomis, Florida.

Happily, only one of ours has passed on to his reward — **Henry T. Koonce** of Bryn Mawr, Penn. I will, at once, write Henry's widow in your names as a Class, and remember that this address — and all others — are available to you upon request. — **Warren J. Henderson**, Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

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Three members of our class were among the 152 alumni honored in December by M.I.T. when the Institute conferred Corporate Leadership Awards on chairmen, vice chairmen, presidents, or managing partners of leading business and industrial organizations in the United States. The three from our class were: **Wilfred D. MacDonnell**, Chairman and Chief Executive Officer, Kelsey-Hayes Co.; **Harold E. Thayer**, Chairman, President and Chief Executive Officer of Mallinckrodt Inc; and **Frank R. Milliken**, President and Chief Executive Officer, Kennecott Copper Corp. Although all of those honored certainly deserve recognition as evidence of the part M.I.T. has played in the industrial leadership of this country, I feel they also serve as "stand-ins" for the great numbers of our alumni who have had the same effect in lesser known companies and industries.

In another area of honors, **Arthur L. Conn** was named one of the four 1976 recipients of the American Institute of Chemical Engineers Founders Award. Art has been with Standard Oil of Indiana (Amoco) since 1939. His career there has been a diversified one, including considerable work on synthetic fuels. He is currently on the ad hoc committee on coal liquefaction of the Nation Research Council and has been concerned with coal research since 1968. Art's present corporate responsibilities are as director of government contracts in the Research and Development department of Amoco Oil Co. Over the years he has been very active in A.I.Ch.E., serving as president in 1970 and was named a fellow in 1971. After delineating such a fine career, the slightly warped thought runs through my mind — does Art still play the banjo as well as he did when he was in the Musical Club?

After, I think, passing through several hands, I have a clipping from the Pennsylvania Power and Light Co. publication that announces the retirement of **Robert K. Moore, Jr.** last October. He had started in 1934 with the Scranton Electric Co., advanced through various engineering assignments and in 1948 was appointed head of its Electrical Engineering Department. When P.P. and L. merged with Scranton Electric in 1956, Bob became a senior project engineer in System Planning at Allentown. In 1959 he was named superintendent of the former Lines and Substations Department and in 1971 promoted to the position he held at retirement — Manager - Distribution Technical Services.

I have a number of Alumni Fund notes, some of which I think I'll save against a possible future drought. Amplifying a brief mention in the December issue, **Sam Prince** says, "Moved to Cape Cod three years ago to take life easier. Am semi-retired and selling land and homes at Holly Point on beautiful Lake Wequaquet in Centerville. My third son, an attorney on Wall Street, is being married in January. His older brothers are married and have Ph.Ds in Math and English Literature. Two grandchildren complete the picture so far."

Max Winer writes, "After graduation I worked in the chemical engineering field with the War Department, Chemical Warfare Service, and the Bureau of Mines, Pittsburgh, Penn., in research and development of synthetic liquid fuels from coal. Since 1950, I've changed my engineering field to civil engineering and am employed presently as Assistant District Construction engineer, Massachusetts Department of Public Works, Danvers, Mass. My wife teaches at the Mason-Rice school in Newton Centre. I have a

married son Elliot, living in Sudbury, and a 6-month-old granddaughter whom we both adore. We spend most of our weekends babysitting. It's a real experience, bringing up children in this generation."

From **Bill Ball, Jr.**, a note: "Will be retiring March 1 from the National Association of Manufacturers. Lois and I hope to find a suitable small home near the Connecticut shore east of New Haven, or on Cape Cod. Until then, we will stay in Larchmont where we've lived since 1945."

Finally, some words from **Ed Asch** (who, if my memory is holding up, was white-haired by either our fifth or tenth reunion). He says, "Working a little when the mood is right. Just returned from a short vacation in Spain, Morocco, and Portugal, Three very contrasting. After several years in the doldrums, the Houston M.I.T. Club has become active and fun." — **Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass. 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Chevy Chase, Md. 20015

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Lester A. Brooks has come to the rescue with an interesting letter: "Ellen had always wanted to see the Canadian Rockies so we took off July 19 and flew to Calgary where I had reserved a car. We drove south on Rt. 2 to Waterton Lakes Park, then up to Kootenay, Yoho, Jasper and back to Banff National Park. The scenery, the wildlife, the ice fields, the glacial lakes—everything is breathtaking. Bathing in hot sulphur springs at Miette (102°F); golf and trout fishing at Jasper were unforgettable experiences. We took the Canadian Pacific overnight to Vancouver, B.C., visited Stanley Park and other points of interest, then traveled to Victoria by ferry to see the Bouchard Gardens, and went south to Seattle by steamer to conclude one of the most exciting and different vacations we have ever had. We then spent time with our daughter Joyce and family in Memphis to help celebrate their tenth wedding anniversary. A business trip in December was almost as exciting. Although Vanderbilt Export has been thriving, we'd never seriously considered doing business with the Russians. The subject was discussed with me early in October. I was to supply the technical backup on our rubber chemicals and oil additives providing a seminar could be arranged. The trip was on when my visa arrived two days before my scheduled departure on December 10. I flew to Zurich, and then to Moscow, and checked in at the Hotel Ukraine. We met three times with delegates of the Russian Oil Ministry and Petrochemical Industries and I think we scored well with the help of an abundance of technical literature. A taxi was always at our disposal, so we had plenty of time to see the town. I wish I dared to take the space and tell you about my experiences. It was a marvelous trip that I wouldn't have missed for the world and I'm hoping I can get back there again."

Francis and **Dexter Clough** in Bangor write: "Three of our children were with us for Christmas: Francis and husband; John, from Mt. Desert; and David, now a reporter for the *Star Herald* in Presque Isle. But this evening finds us alone by the fire. Francis is much better, but it's been only in the past two months — nine since the auto accident a year ago — that she's felt like her old self." We were completely unaware of the accident and are delighted that Francis is recovering from her injuries.

It was good to receive a letter from **Ham Dow**: "Since receiving your last golf bulletin, I have played relatively little golf although the weather has contiued ideal for it. In early December **Frank Hatch** had me over to play Stanford again. I had terrible putting and managed only a mid-90 score; Frank had even more trouble and was over 100. I shall have him over here to play in mid-January. In late October Edith and I flew to Long Island for her niece's wedding. We were away two weeks and managed to visit in Connecticut, including a quickie stop with Anni and **Irving Banquer** at Heritage Village, and down to Washington, D.C., and Williamsburg, Va. We and our close neighbors spent Christmas at San Diego with our daughter Merri and her husband, Ron. While there we hosted a Christmas Chinese banquet to which I have invited the Banquers who are now in La Jolla for three months. Their youngest daughter, Carol, is now interning as a pediatrician at the Oakland Children's Hospital. Merri played an impromptu recital for us all; it was the first time the Banquers had heard her since she played at our 25th Reunion at Chatham Bars Inn."

Many thanks to all for the letters and notes, the rest of which will be included in next month's issue. — **Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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Class members have responded with both contributions to the Alumni Fund and news for your Secretary. **Norm Bull** reports from Neenah, Wisc., that he expects to retire (may already have) during 1977 but has no specific plans. . . . **Roger LeBlanc** was hospitalized for a heart seizure in Manchester, N. H. He was home when he wrote. . . . **Gerry McMahon** and Catherine very much enjoyed our 40th reunion and are looking forward to the 45th. He has been with Cities Service for 40 years and is beginning to "think about retirement." . . . **Pete** (F. S.) **Peterson** reports that both sons are in the Air Force; Major Kenneth is a fighter pilot at Otis A.F.B. and Lt. David is a management analyst at Eglin A.F.B. . . . **Laddie Reday** was off again in January to Marrakesh via London and Portugal. He has some industrial building in the works and has also appeared in print in several magazines and newspapers. Time does not hang heavily on Laddie's hands.

Eldon Dunlap writes that following his retirement from Chevron Oil Co. last July, he and Ruth left Denver for a motor trip through the Southwest and have since been catching up with a "little golf." . . . **Arthur Bearse** retired from Battelle Columbus Laboratories last September.

M.I.T. Coporate Leadership awards were conferred on six members of our class, three undergraduates and three as graduates. The former are: **Robert Gillette** (National Life Insurance Co.), **Semon Knudsen** (White Motor Corp.), and **George Trimble** (Bunker Ramo Corp.); the latter are **John Fluke** (John Fluke Manufacturing Co.), **William Hewlett** (Hewlett-Packard Company), and **Howard Turner** (Turner Construction Co.)

Word has been received of the death on last November 24 of **John J. Petrossi** of Rochester, N. Y. He spent two years at the Institute following three years at Holy Cross College but left without finishing the requirements for his degree. He became a millionaire in the concrete business and then dealt in downtown Rochester real estate. He was owner and chief executive of the Rochester Lancers professional soccer team and also bred race horses. He was active in civic affairs and was a commissioner of the Rochester-Genesee Regional Transportation Authority. He is survived by his wife and a daughter to whom the class extends sympathy. — **Alice H. Kimball**, Secretary, P. O. Box 31, West Hartland, Conn. 06091

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The Institute recently conferred Corporate Leadership Awards to its alumni who are chairmen, vice chairmen, presidents or managing partners of many of the leading business and industrial organizations in the United States. Our class was well represented with awards conferred on **William E. Hartmann**, Partner, Skidmore Owings and Merrill, Chicago, Ill; **William J. McCune**, President and Chief Operating Officer, Polaroid Corp. Cambridge, Mass.; **W. Gardner Barker**, Chairman and Chief Executive Officer, Thomas P. Lipton, Inc., Englewood Cliffs, N.J.; and **Alfred E. Busch**, Chairman of the Board, Keuffel and Esser Co., Morriston, N.J.

Bernhard Schondorff, Erkelenz, West Germany, was honored with the "Bundsverdienstkreuz am Bande" by the President of West Germany. . . . **James D. McLean**, President of McLean and Co., was appointed Regional Director, Emergency Field Organization, U.S. Federal Region 9, U.S. Department of Transportation.

John Jacobs is still a chemical engineer at Bechtel and still averages over 100 days a year skiing. His daughter is having two books published and his wife is still sculpturing. . . . **Berkley Bishop** writes that he liquidated Kotal Co. Inc., his employer for 30 years. He also sold the Oasis Motel this year so he is now retired and living in Florida. . . . **Bob Winans** has retired from Bell Laboratories and is looking for a sailing area in which to relocate. . . . **Bill Muckenhirn** gave up the chairmanship of the electrical engineering department, University of Toledo after eight years in August, 1973. He then served as acting Dean of the Graduate School in 1974-75 and then acting chairman of the electrical engineering department from 1975-76. He is now back teaching and research which he enjoys. . . . **Farmer Current** has retired from Oilwell Division, U.S. Steel. His daughter hopes to get her Ph.D. from Yale this spring and his son is an assistant tennis pro at the Racquet Club in Pittsburgh. . . . **Joe Smedile** writes that Martha is making progress from her stroke. They took a trip to Europe in October. Their son Gary is still in New York City with TWA. Joe is still with Northeastern Planning Commission. They hope to be able to attend our 40th Reunion in June. Your 40th Reunion committee has had several meetings and the response has been excellent; we will stay on the M.I.T. campus with a format similar to the one of our 25th. If you haven't done so already, let us know right off if you can make the 40th. — **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Lester Klashman**, Assistant Secretary, 198 Maple St., Malden, Mass. 02148

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Plans are underway for our 40th Reunion. Block off June 8-11, 1978 — that's the magic date. In January a group of us, including **Norm Leventhal, Haskell Gordon, Frank Kemp, Roy Hopgood, Lou Bachmann, Paul Des Jardins**, and **Howie Millius**, met in New York to discuss plans. Haskell is the Chairman of the Class Gift Committee, and **Ed Hadley** will be editor and publisher of an alumni reunion book, *1938 Revisited*.

Jim Maguire writes: "For the past ten or 12 years I have been an engineer gone wrong — have been in the Industrial Relations field to which most Irishmen sort of gravitate to naturally. Presently I am Director, Personnel, for Monsanto's Facilities and Planning Staff, a group which includes our worldwide Engineering Department, Manufacturing Association, Purchasing, Energy Products and some other assorted groups. This year I got tagged for the office of President of the M.I.T. Club of St. Louis, which boasts of some fellow members of the Class of 1938 — **Dave Wright, Fred Du Bois** and others. We are looking forward to our 40th Reunion in 1978."

A note from **Dave Baker**: "I have just published a two-volume postal history of Indiana. I am a member of the Board of Corrections for the State of Indiana. Our subsidiary, The Baker Forms Co., just finished forming the reinforced concrete for the largest privately financed construction project in the State of Indiana, The Merchants Plaza."

A sad note — I received belated notice that **Rudy Vogel** passed away last June. — **A. L. Bruneau**, Secretary, Hurdman and Cranstoun, 140 Broadway, New York, N. Y. 10005

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Four of our classmates have been especially honored to receive M.I.T.'s Corporate Leadership Award. This Award honors individuals whose responsibilities in private industry marks them as exceptional contributors to the strength and well-being of this nation. Our congratulations go

especially to these four men: **Bill Brewster**, Vice Chairman of Emhart Corporation; **Harold Pope**, Chairman of Sanders Associates Inc.; **Maurice Granville**, Chairman and Chief Executive Officer of Texaco Inc., and **Donald Procknow**, President of Western Electric Company.

Pierre M. Honnell was named Professor Emeritus of Electrical Engineering, and he retired from Washington University where he had been a member of the faculty for the last 31 years. — **Hal Seykota**, Secretary, 2561 Via Viesta, La Jolla, Calif. 92037

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Roll Call Response: **Bonner Hoffmann** answered our call after returning from a Grand Bahama vacation. He writes glowingly of the island which caters to mainland Americans and Canadians. Since 1955 Bonner has been with Gender, Paeschke & Frey in Milwaukee and is now a director and first vice president and secretary. He also serves on the boards of other companies as distant as Florida.

Retirement Becomes You: **Edward S. Carnrick** retired from the Department of Industrial Engineering at San Jose State University in 1971, but continues with gentlemanly farming on his acres in nearby Saratoga, Calif. **Thomas F. Creamer**, formerly executive Vice President of Citibank in New York, is now spending full time as Vice Chairman of the Economic Development Council of New York City. He resides in Scarsdale.

Cold and Sunny: **Charles Edwards** (and wife D.J.) are successful transplants from Pasadena, Calif., to Grand Junction, Colo. D.J. is selling insurance and Charles is with Bendix's Natural Uranium Resource Evaluation Program. Their holiday card shows a sylvan setting for their new home, halfway between Salt Lake City and Denver.

Diode Users Please Note: **Peter Toong** writes that he and his pals at International Diode Corp. have developed a "very fast switching germanium diode in the pico and nano-second range with low forward voltage drop." He resides in Jersey City.

From Nashua: **David Sunstein** left Philadelphia and the presidency of a company for life in New Hampshire. Now active as a consultant in electronics, he writes, "living and learning are great fun most of the time."

No Stranger Here: **Amos E. Joel, Jr.**, recently in this column for his I.E.E.E. Alexander Graham Bell Award, is the editor of the newly published *Electronic Switching: Central Office Systems of the World* (Wiley).

Good New Fellow: **F. B. Stern,** field engineer for Magnaflux Corp., New York, has been elected a Fellow of the Society for Experimental Stress Analysis.

Silver Bowls: M.I.T.'s Corporate Leadership Awards, in the words of Corporation Chairman, Howard W. Hohnson, "recognize the significance of creative and effective leadership in business and industry in our national life and the role of the private enterprise system in our national character and well-being." In New York on December 3, 152 business and industry executives were cited for being exceptional contributors to the strength of the naiton. Tangible evidence of the citation for each was a silver bowl, suitably inscribed.

The Class of 1940 is honored by the inclusion among the awardees, our classmates: **Robert K. Deutsch**, L.D. Schreiber Cheese Co., Green Bay, Wisc.; **W. H. Krome George**, Aluminum Co. of America, Pittsburgh, Penn.; **Oliver G. Haywood**, Huyck Corp., Wake Forest, N.C.; **Jerry McAfee**, Gulf Oil Corporation, Pittsburgh, Penn.; **I.M. Pei**, I.M. Pei and Partners, New York, N.Y.; and **Henry E. Singleton**, Teledyne, Inc. Los Angeles, Calif. All are chief executives of their companies or chairmen of their boards. Krome George, by the way, recently became a Member of the Corporation of the Woods Hole Oceanographic Institution.

Hail and Farewell: to **J. Latimer Jones**, who died September 11, 1976, in Santa Barbara, Calif., and to **Samuel Silver**, who died on November 5, 1976, after a heart attack, in Walnut Creek, Calif. — **Frank A. Yett**, Secretary, 1405 Ptarmigan Dr., Walnut Creek, Calif. 94595

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It is 17 below zero in Pittsburgh as I write, and you will be reading about it in the March/April issue. It's a warming thought.

The headline said "M.I.T. Confers Awards on 152 Business and Industry Executives." These are alumni who are Chairmen, Vice Chairmen, Presidents or Managing Partners of the leading business and industrial organizations in the U.S. Classmates so honored are listed below: **Eugene C. Gwaltney**, President and Chief Executive Officer, Russell Corp., Alexander City, Ala.; **Arthur S. Spear**, President and Chief Executive Officer, Mattel, Inc., Hawthorne, Calif.; **Frank S. Wyle**, Chairman of the Board and Chief Executive Officer, Wyle Laboratories Inc., El Segundo, Calif.; **E. Kirkbride Miller**, Chairman, T. Rowe Price Associates, Inc., Baltimore, Md.; **Raymond C. Foster**, Chairman, Stone and Webster, Inc., New York, N.Y.; **Joseph G. Gavin, Jr.,** President and Chief Operating Officer, Grumman Corporation, Bethpage, N.Y.; **Ralph Landau**, Chairman and Chief Executive Officer, Halcon International, Inc., New York, N.Y.; **Carl M. Mueller**, Managing Partner, Loeb, Rhoades and Co. New York, N.Y.; and **Nathan R. Owen**, Chairman and Chief Executive Officer, General Signal Corporation, New York, N.Y.

Roger Finch is also in the news. ERDA has contracted with the Engineering Societies Commission on Energy, Inc. (ESCOE), of which Roger is Executive Director, to perform independent and objective evaluations of the design and economics of alternative fossil energy research programs. ESCOE will recruit a group of engineers from diverse disciplines to serve on loan from their parent companies or colleges as employees of ESCOE for two years at their Washington, D.C., office. Roger is also Executive Director and Secretary of the American Society of Mechanical Engineers.

Family news from **Ivor Collins** tells that Bruce, 25, is at G.E. Credit Corp. in Stamford, Conn.; Judy, 22, is working on a Master's degree in Resource Management at University of Wisconsin; Alan, 19, is a sophomore in engineering at Cornell. Shirley and Ivor enjoyed the 35th Reunion tremendously. They vacationed in Holland, Germany and Austria. . . . **Dave Shapiro** reports he and Adele enjoyed the 35th Reunion. He is working at building his export company — handling a wide range of high technology products. . . . **Henry Arnold** is Director, Office of Science and Technology Agency for International Development.

On the unhappy side we have received notice that **Muller Moody** died on November 28, 1976. Our condolences to his family.

Keep sending in the news — we can handle it. — **Henry Avery**, Secretary, U.S.S. Chemicals, 2863 — 600 Grant St., Pittsburgh, Penn. 15230

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Bob Imsande, Director of Environmental Engineering, Anheuser-Busch, Inc. was quoted in a recent *Business Week* article, "I would sooner see the statutory regulations spelling out what's required environmentally . . . but as long as the laws remain the way they are, mediation is preferable to doing nothing or getting tangled up in court for years." . . . **Marty Levene** is the principal developer of the new Cancer Treatment System which uses a computer to minimize radiation damage to healthy tissues near the tumor's site. Marty is Deputy Director of the Joint Center for Radiation Therapy at Boston's Beth Israel Hospital.

Bob Olsen has retired after 16 years as Technical Director of the Fine Chemicals Department of Ashland Chemical Co. His new address is P.O. Box 483, Eastham, Mass. Bob writes that he intends to consult and to grow wine grape vines from his own half-acre experimental vineyard. Wonder whether we are in time to get some Olson Wine for the 35th Reunion. . . . **Bob Howard** is currently doing some technical work involved in main computor memory packaging. . . . **Bob (Hawkshaw) Shaw** has been appointed positions with the State of New Hampshire's Public Health Service and Labor Department and with the Hillsborough County Attorney's Office. He is doing work as an "expert" in civil and criminal cases involving alleged wrong-doing by medical doctors. Apparently, this dovetails with **Bob Rine**'s activities so we might hear from them both in June.

Bert Clear has been promoted to President and Chief Operating Officer of Stanley Works. Our congratulations to Bert. This makes me wonder just how many of our classmates are either Chief Executive Officers or Chief Operating Officers of major corporations. Would all who qualify please drop me a line!

George Schwartz, our Reunion Chairman, says that 80 classmates are showing interest in the 35th Reunion by sending in their class dues. All of you who were at the 30th remember that it was a great weekend. I am assured that this will be even better. If you have not done it yet, how about getting on board now! As usual, my closing plaintive plea for news. Let's hear from you. — **L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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In a new and unique way, M.I.T. honored 152 of its alumni last December by conferring Corporate Leadership Awards to individuals whose responsibilities in private industry mark them as exceptional contributors to the strength and well-being of this nation. Our classmates who were so honored were: **Rudy Hurwich**, Chairman, Dymo Industries; **Charles Gates**, Chairman and President, Gates Rubber Co.; **Irenee duPont**, President and Chief Executive Officer, Christiana Securities Co.; **Edward R. Kane**, President, E.I. duPont de Nemours & Co., Inc.; **Walter A. Netsch, Jr.**, Partner, Skidmore, Owings & Merrill; **John C. Stetson**, President, A.B. Dick Co.; **Leo Feuer**, President, William Carter Co., Needham, Mass.; and **Jimmy Spitz**, President and Chief Operating Officer, International Flavors and Fragrances, Inc., New York, N.Y. We are certainly proud of these gentlemen!

Harry W. Fritts, Jr., Professor and Chairman of the Department of Medicine, School of Medicine of the State University of New York at Stony Brook, was appointed to the National Heart, Lung and Blood Advisory Council of the National Heart, Lung and Blood Institute. This group meets periodically to consider applications for research and training support in these fields, and reports to the President and Congress on the doings of the Institute, the NHLBI, that is.

John J. Guarrera, of the School of Engineering and Computer Science, California State University at Northridge, has been elected vice president for professional activities of the Institute of Electrical and Electronic Engineers. He was formerly president of Sancom, in Sun Valley, Calif. . . . One of my local friends ran into **Iz Lenzner** on the links at Harbor Island, Fla., last week, and reports that Iz is the toughest 18 handicap swinger he has ever met. So be wary when he invites you to his home course near White Plains, N.Y. . . . Our class treasury has a balance of $632.28 in the Society for Savings, Hartford, Conn. — **Richard M. Feingold**, Secretary, 779 Prospect Ave., West Hartford, Conn. 06105

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Thanks for holiday cards from **Frank Chin, Andy Corry, Lou Demarkles, Sam Lamport, Bob Veitch** and **Larry White**. Incidentally, Bob is back in his New York home after having spent some time working in Georgia.

Richard Hatfield and Nat have moved out of the Washington area to Chicago. Dick is Senior Vice President of Central Scientific (who can forget that name!). They'd like to hear from any Chicago area classmates. . . . **John Granlund** and Vee have left New York for the Blue Ridge life.

Deep in New York City, near the U.N., are **Edwin Roos** and Milena (Pyluchova before July '75). She's with the F.A.O.; he's with William Real Estate and is active in energy matters. . . . **David Bailey** is approaching the energy situation in a different way. He's applying his knowledge and experience in tensioned hydrofoils to work on large-span units for extracting electrical energy from the winds. . . . **Stan Smock** (course X and XV) is also tapping nature's energy. Last June he moved into a new house equipped with solar heating. It uses a rock bin for heat storage and air as the transfer medium. In Gunnison, Col., he has the obvious altitude advantage (8,000 ft.) and over 300 clear days per year. Of course, with the long heating season and high fuel costs the savings can be quite dramatic.

Ray Frodey is still a vice president at Gerbers but is now involved in amateur radio. Any other "hams" in the class who can C.Q. (or whatever it is they do) with him? . . . **Herb Carpenter** continues as Director of Research of Greif Corp., and is now also a vice president.

John Cornell comes back to Massachusetts as Executive Director of Westwood Research Laboratory. John continues his 25 years of contributions in the field of dental research, this time in his own company. . . . **Lawrence Dowd** continues active in business, golf, and racketball. These probably help keep his mind off tuition costs; he has two sons at University of Illinois and three daughters at Harper Junior College. . . . In this category, hats off to the **Cavicchi (Richard H.)** with two offspring at M.I.T. Elizabeth (1978) has a double major VIII and XXI-B. (Look it up. I didn't know either but it's enlightening to see what M.I.T. offers today in curricula.) Richard E. is in the Class of 1980, (that's freshman year now). In case anyone tries to give Dick or M.I.T. too much credit for this, remember that Mary Anne Cavicchi won her Ph.D. in political science from Case Western Reserve just last June!

And now, with special pride, we include the names of several of our distinguished classmates who have earned M.I.T.'s Corporate Leadership Awards, conferred in December at the Waldorf-Astoria in New York by Howard Johnson and Jerome Wiesner: **A. Donald Arsem**, Wurlitzer Co., Ill.; **Langdon S. Flowers** (first president of the class of '44), Flowers Industries, Georgia; **Roger Freeman, Jr.**, Allendale Mutual Insurance Co., Rhode Island; **Albert P. Hildebrandt**, Mayhill Homes Corp., Georgia; and **Clint W. Murchison, Jr.**, Murchison Brothers, Texas.

To end with a warm thought, **Arturo Morales** is all set to wrok for a future reunion in Mexico City (as discussed at the Bermuda 35th). We are sure that he and Elvira would provide a warm reception for Class of '44 travelers. — **Melissa** and **Newton Teixeira**, Class Secretaries, 92 Webster Park, West Newton, Mass. 02165

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Congratulations to **Bernard J. O'Keefe**, President, Ocean Spray Cranberries, Inc., Hanson, Mass.; **Dave Clare**, President and Chairman, Executive Committee, Johnson & Johnson, New Brunswick, N.J.; and **Frank J. Graziano**, President, Crompton & Knowles Corp., New York, N.Y. These three '45ers received Corporate Leadership Awards from the Institute at a Corporation luncheon at New York's Waldorf Astoria on December 3.

Hedley V. Patterson of Woonsocket, R.I., recently completed a year as President of the Municipal Public Works Assoication of R.I. as well as his third year on the Board of Directors of the R.I. Society of Professional Engineers. . . . **Norm Saunders**, a Weston, Mass., professional engineer, is well known in the field of solar energy. Norm recently designed a solar heating system for the Cambridge School dining room. . . . **J. J. Strand** says he is still plugging along as President of Lempco Industries, Inc., in Cleveland — and well he is with Jeff, age 24, in his second year at Yale Law, Lyse, age 22, in her first year at Case-Western Reserve Medical School, and Nina, age 20, in her junior year at Radcliffe.

Tom Hood, Executive Vice President of Vermont Marble Co., was elected President of the Vermont State Chamber of Commerce last November. Tom is a Californian who came East to the Institute and never returned. He was a combat engineer during World War II, and spent some 16 years at George A. Fuller in New York before joining Vermont Marble in 1963.

Al Oxenham is now settled in Arlington, Va., and his consulting practice is thriving. At the moment, Al is conducting a study on high technology surface active particulates, including catalysts, catalyst carriers, absorbents, and desiccants; it takes him all over the U.S. and Europe. . . .**Richard B. Marsten** continues at C.C.N.Y. as Dean of the School of Engineering.

The **Jerry Patersons** have left the Binghamton, N.Y., area for Fort Worth, Tex. Quoting Jerry, "Finally got fed up with the climate, both physical and economic, in New York so we have joined the great migration to the sun belt. No kids left at home so this seemed to be the best time to make the move." Jerry is Assistant to the President of General Steel Co., a subsidiary of Howell Instruments, Inc., which is up Jerry's alley in that General is a large fabricator of structural and plate.

The **Chris Bolands** reported that son Rick is M.I.T. '80, which means that there are only three remaining at home! . . .The **George Bickfords** moved all of two miles this past summer to a lakefront location: Rob at Colgate; girls job-hunting. Betty is still teaching and George is happy running the Service Parts Operation at Carrier in Syracuse.

The **Sherry Ing** family grows more handsome with time and age. . . . Jan and **Charles Patterson** have started a drive towards an off-year reunion similar to our trip to Spain in 1973. Son Chip is in California to ski and work, and Sue is enjoying the University of Vermont. . . . A nice note from **Tom Stephenson** reports that he and Jimmie will be East some year soon.

Ellen and **Jim Brayton** advise that Flint is working for the Federal Reserve Board in Washington, and Leslie and Dana are scheduled to enter the job market in June. . . .**Nick Mumford** continues as Director of Engineering, LTV Vought in the Detroit area. — **C. H. Springer**, Secretary, P.O. Box 288, New Castle, N.H. 03854

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A. B. Burns conducted a three-day seminar on Shock and Vibrated Mitigation for N.Y.U.'s School of Continuing Education last October. A similar seminar is scheduled for May, 1977, in Chicago. . . . Professor **Herschel A. Elarth** has announced his 1977 retirement. . . . **William J. Casey** has been named President of Amsted Industries International, effective December 1, 1976, after 30 years at Amsted. Bill joined American Steel Foundries in 1946 and served in various technical and sales positions until 1962, when he joined the International Division. The International Division sells Amsted railroad products and industrial castings overseas and negotiates licenses.

On December 3, M.I.T. conferred Corporate Leadership Awards on 152 of the alumni who are officers of leading business and industrial organizations in the country, including **Roger P. Sonnabend**, Chairman, Sonesta International Hotel Corp., from the Class of 1946. — **Russell K. Dostal**, Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

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The 30th reunion committee has been meeting regularly and their plans for June 9 to 12 will provide something for everyone. **Donald Van Greenberg** is Reunion Chariman, and the committee members are **Claude Brenner**, Class President; **Harl Aldrich**, **Virginia Carter Grammer**, **Hubert Flomenhoft**, **Al Richardson**, **Dick Knight**, **Parker Symmes**, **Bill Hawley**, **George Katz**, and **Irving Schwarz**. You will be receiving information about the reunion activities shortly and it promises to be an event you can't afford to miss!

Bob Creek writes that he has been elected a member of the Federal Relations Network, National School Boards Assoc., and the Purdue Privacy Research Foundation. . . . **Bob Athow** advises that he was recently promoted to Principal Professional Electrical Engineer in charge of main station design at Tacoma City Light. . . . **Bob Whorf** dropped a brief note to advise that he now has his own consulting business in the Philadelphia area, Robert Whorf & Assoc. His major emphasis is on policy-relevant research and the analysis of public-private sector interactions and strategic planning.

Joe Childs is now staff engineer — Nuclear Power Products and Standards for the Foxboro Co., in Foxboro, Mass. His wife is working in the public school system as a learning disabilities specialist and they have four sons, aged 16-21, two in college and two in high school. . . . **Moses Arens** writes from Israel that after many years in aeronautical engineering, he has drifted into systems and policy analysis and has lectured on the subject of impact of science and technology on national policy. His interest in government must at least partially be due to his being a member of the Knesset, Israel's parliament.

The following members of our class received Corporate Leadership Awards from M.I.T. (They are chairmen, vice chairmen, presidents or managing partners of leading organizations of the U.S.): **Paul M. Cook**, President, Raychem Corporation, Menlo Park. Calif., **Robert E. Siegfried**, President and Chief Executive Officer, The Badger Co., Inc., Cambridge, Mass.; **Bernard G. Palitz**, Chairman, Commercial Alliance Corp., New York, N.Y.; **Mario A. DiFederico**, President, Firestone Tire & Rubber Co., Akron, Ohio.

Hope to see you at reunion in June. — **Dick O'Donnell**, Secretary, 28516 Lincoln, Bay Village, Ohio 44140

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On December 3, M.I.T. Conferred Corporate Leadership Awards on 152 of its alumni who are chairmen, vice chairmen, presidents, or managing partners of many of the leading business and industrial organizations of the United States. Eight of the 152 recipients of this Award are members of the class of 1948. Our class was better represented than almost any other class. Our classmates so honored are: **George M. Keller**, Vice Chairman, Standard Oil of California, San Francisco, Calif.; **Lester L. Kilpatrick**, Chairman, California Computer Products, Inc., Anaheim, Calif.; **Denman K. McNear**, President, Southern Pacific Transportation Co., San Francisco, Calif.; **William R. Zimmerman**, President, Monogram Industries, Inc., Santa Monica, Calif.; **William J. Weisz**, President and C.E.O., Motorola, Inc., Schaumberg, Ill.; **C. Vincent Vappi**, President, Vappi and Co., Inc., Cambridge, Mass.; **Alfred J. Murrer**, President and C.E.O., The Gleason Works, Rochester, N.Y.; and, **Frank A. Jones**, President, Cook Industries Inc., Memphis, Tenn. — Congratulations, gentlemen.

I had lunch with **Curtis Green** at Tulsa's Louisane Restaurant. Curtis drills oil wells for himself and other investors. This year Curtis is president of the M.I.T. Club of Oklahoma. Curtis has two daughters in college. Susie is at Northwestern and is considering graduate studies in law. Jane is studying in Texas.

I called **Bill Zimmerman**, since the last time I had some news was in 1970. Then, I had to go to Los Angeles to get the news. Bill is president of Monogram Industries. Monogram owns many businesses: electrical insulation; metal products; fasteners; sanitation products; and real estate, garden apartments. Bill was recently elected a director on the board of Electronic Memory and Magnetics, a N.Y.S.E. Co. Bill is leaving for a business trip to Saudi Arabia. When Bill is home he lives in a great big funny old house with a tennis court and swimming pool.

Sonny Monosson and Bill Grinker, '56, have opened the world's biggest computer store on Commonwealth Ave. near Kenmore Square in Boston. During their two-day grand opening, over

2,350 computer hobbyists, as well as suppliers of the new personal computer kits, were able to meet, talk about, and try out the very latest in personal computing gear. Just one year ago there were no stores devoted to the computer hobbyist, now there are 78. Sonny's store is the largest and in keeping with this, during the grand opening, the store gave away computer equipment originally worth a total of $100,001 as prizes. Each hour a hobbyist vistor selected by computer was awarded a piece of computer equipment. Mark Haiman, an M.I.T. freshman, won a 500 pound, fivefoot-high piece of gear that he wheeled back to the dorm.

Phil Bragar writes from Israel that he is working with a group of ex-Russian engineers to establish a factory to manufacture machine tool related devices and related hardware. Lower Israeli labor costs and duty free entry to the E.E.C. countries are expected to provide the basis for a joint venture with American companies. Phil is working with smaller Israeli firms to identify and then export products to the U.S. The larger Israeli firms already know the export business. Phil would like to hear from classmates on possible joint ventures with U.S. companies. The experiences of an immigrant in a new country are described in a newsletter that Phil sent: "Israel is a product of Russian socialism, British bureaucracy, and American capitalism, with the worst features of each!"

Norm Kreisman wrote that his company is developing video-based facsimile storage, retrieval and transmission systems. Norm's company has contracted with Fairchild Space and Electronics in Germantown for the development, but there is some cooperative marketing also. The system uses a patented approach to a hybrid high-resolution/low-resolution system that provides a high-resolution display using low cost, mass produced, standard band width video storage equipment. Norm's wife Gloria is copy chief at Garfinckels in Washington, D.C. His daughter, Polly, is a junior at Cornell and an editor on the paper. His younger daughter Jane is finishing prep school and applying to colleges for studies in art, sculpture, and graphic design. — **S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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As a result of early snowstorms and extended cold, in late January my driveway is a disaster area and the house is surrounded by ice stalactites/stalagmites, which extend from roof to ground at the front and roof to porch at the rear, generated by the heating cables which so far have kept the roof from leaking. Let us hope that this worst winter is history is well behind us when you read this column. From alumni fund envelopes, we learn that **Gregory Lynes** joined the Systems Engineering staff of Dynatrend, Inc., in Burlington, Mass., in early December 1976, where he has run into several M.I.T. alumni. He reports "my new family and I are very excited about the prospects."

A distinguished group of classmates were among 152 alumni to receive M.I.T. corporate leadership awards by virtue of being chairmen, vice chairmen, presidents, or managing partners of some of the leading business and industrial organizations in the United States. In alphabetical order, they are: **Angelo R. Arena**, Chairman, Nieman-Marcus Co., Dallas; **William S. Edgerly**, President, State Street Boston Financial Corp.; **Sidney C. Howell**, President and Chief Operating Officer, The Weatherhead Co., Inc., Cleveland; **John O. Merrill, Jr.**, Partner, Skidmore, Ownings & Merrill, San Francisco. Congratulations to all.

Dr. **David Israel**, Director, Office of Programs Integration, Energy Research and Development Administration, has been appointed to the Federal Coordinating Council for Science, Engineering and Technology. The Council, established by Public Law 94-282, is set up to consider problems and developments in fields of science, engineering, and technology and related activities which affect more than one federal agency. Its objectives are to achieve better planning and administration; identify research needs; bring about more effective use of resources and facilities; and broaden and improve international cooperation in science, engineering, and technology.

From his annual Christmas letter, it sounds like **Jack Fogarty** lived through a hectic 1976, during which he was in touch with some pretty esoteric subjects. Peggy Fogarty writes, "In some ways it seems only a couple of months since last Christmas but then I recall all those crazy trips we took, Jack's working around the clock for two months, Barbie's getting off to George School, the Electro-Physics Lab's collapse, and all the bother of getting a new job.

"Yes, I.T.T. summarily scuttled its entire Columbia laboratory and Jack once again found himself up for grabs. I.T.T. offered us a transfer to Nutley, N.J. (if you consider that an offer), but instead, Jack joined Westinghouse in their TCOM subsidiary, right here in Columbia, Md. TCOM (Tethered COMmunications) designs and operates TV transmitters and radio-telephone repeaters which are suspended two miles up in the air on moored balloons. These 'aerostats' look like something out of Jules Verne but actually they constitute the missing link between antenna towers and satellites and are well-suited for use by developing nations. They're aready able to bring reruns of 'I Love Lucy' to Iran and Korea and soon will be put up in Nigeria.

"During the summer, Jack averaged 60 hours a week working on an ice-floe tracking system for the Canadian Marine Drilling Co. to use in their arctic oil exploration. This system gives the drillship an early warning to pull up its pipes and get out of the way before a big ice cube moves through. Polar bears are reputed to be a real bother to any hardware placed on the ice . . . things are pretty dull in the arctic so *any* new object attracts the curious bears from miles around. . ." — **Frank T. Hulswit**, Secretary, 77 Temple Rd., Concord, Mass. 01742

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Jack C. Acton was appointed President of the General Electric Co. of Mexico in January, 1976. Jack and his wife, Louise, live in Mexico City; Their daughter, Judy, received her Master's degree in industrial pharmacy this year and is working for H.V. Shuster Co. of Boston. Their son, John, is in the graduate school (of biology) in the University of Miami.

After ten years in California and 20 years in design/management of Polaris/Poseiden missile work, **Richard H. Holmberg** is back east to his first love — electronics, as Vice President and General Manager of International Signal and Control Corp. Dick has three grown children — 23, 20 and 16.

We regret to announce the death of **Claude J. Pasquier** in July, 1976. Claude lived in Severna Park, Md.

Alan G. Bates has been Vice President and General Manager of the Agricultural Chemicals Division of I.C.I. United States for nearly two years. He is fully challenged by the launch of a new-generation insecticide called "ambush," which knocks the tar out of worms that destroy cotton and does a good job on boll weevil, too. On the fun side, Alan tells us that he and his wife spent a fantastic three weeks at Club Mediterranee in Tahiti. He reports that they both deserved it after putting up with each other for 25 years!

We hear that **John J. Earshen** has joined Metrosonics Corp. of Rochester as Director of Applications Engineering, and National Sales Manager. The company manufactures acoustical measuring instruments. . . . **Walter K. Fales** is Chief Engineer — Vehicle Systems in Chrysler Corp., Warren Defense Division. Their major task is production of the M60A1 tank. Walter's oldest son graduated from the University of Michigan two years ago as a naval architect, and his other two sons are attending M.S.U. and Albion College.

Nathan M. Fales formed N.M. Fales, Inc., in December, 1969, as a manufacturer's representative for several pump companies covering the fields of standard industrial and chemical pumping, fuel oil, and high-viscosity liquid pumps, including hot-melt polymers.

On December 3, M.I.T. conferred Corporate Leadership Awards on 152 of its alumni who are chairmen, vice chairmen, presidents, or managing partners of many of the leading business and industrial organizations in the United States. Among those honored by Howard W. Johnson, Chairman of the M.I.T. Corporation, who presided at the luncheon: **William W. Keefer**, President, Warner Electric Brake and Clutch Co., South Beloit, Ill.; **Kenneth H. Olsen**, President, Digital Equipment Corp., Maynard, Mass.; **T. Marshall Hahn, Jr.**, President, Georgia-Pacific Corp., Portland, Ore. — **J. T. McKenna**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

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Marvin E. Goody has recently been made chairman of the Mayor's Arts Commission for the City of Boston. He is also helping to re-design the Animal Care Facilites on the M.I.T. campus. **Charles E. Maki** has become President and General Manager of Northern Telecom, Inc., Raleigh, N.C.

We regret to report **William N. Bley** passed away in October. He was Assistant Chief of Nuclear Engineering for Stone and Webster Engineering Corp., Boston. He is survived by his wife, Evelyn, a daughter, Linda, and a son, William, Jr.

Portrait sculptures by Brookline artist **Beatrice Paipert** were on view in the M.I.T. Faculty Club Lounge through last November. Included in the exhibit were portraits of the late Norbert Wiener and Minor White, former President James R. Killian, Jr., and Julius Stratton. Ms. Paipert is a dancer, actress, and art teacher as well as a sculptor. She danced professionally with the Hans Wiener Dance Company, was acting member of the Poets Theater in Cambridge and has acted at the O'Neill Playhouse in Provincetown and the Loeb Drama Center in Cambridge. She was education director for the I.L.G.W.U. Northern New England District and has taught at Beaver Country Day School, Wellesley College, and the Cambridge Center for Adult Education.

Orlo (Bill) Powell entered his first political campaign this fall, running for State Representative from District 29, Wethersfield, Conn. He owns his own consulting engineering firm specializing in solid waste management. Bill and his wife, Nancy, have three children.

Greg Gentleman's wife, Julia, won reelection last November to her second term in the Iowa State House of Representatives. Her campaign slogan was "Keep a Gentleman in the House."

Markwick K. Smith retired last year as Executive Vice President of Texas Instruments, and has moved to Norwich, Vt., to launch a second career as an author — not of technical papers on geophysics or on corporate management — but of fiction. He has completed a number of short stories so far, but nothing he feels are yet ready to publish.

Larry Kuszmaul is still with the Arundell Corp. in Baltimore, Md. Larry, his wife Harriet, and daughter Ellie, topped off the reunion with a week's trip to London.

John H. Bergmann has formed his own consulting firm, John H. Bergmann Ltd., specializing in brewing and food processing technology, and has been spending considerable time in South America. . . . **Walter C. Kinzinger** has just returned from one month in Europe as part of the MITRE Study Team supporting HQ USEUCOM in Stuttgart, Germany. Walter is currently Group Leader at MITRE in charge of a future D.C.S. architecture study for the Defense Communications Agency. . . . **Edward A. Handy** is now in his seventh year in Cambridge working as Community Development Block Grant Coordinator. . . . **Wallace B. Lebowitz**, M.D., is currently Program Director in Cardiology, St. Vincent's Medical Center, Bridgeport, Conn., and Assistant Clinical Professor of Medicine, Yale University

Take One Meteorology Degree and 300,000 Pounds of Orange Juice Futures . . .

Only 94 bachelor's degrees have ever been awarded in meteorology by M.I.T., but at least one of them has paid off generously.

Consider the case of Peter R. Leavitt, '52, who runs a private weather forecasting service — Weather Service Corp. — in Bedford, Mass. He was one of a handful of meteorologists, nationwide, who took a special look at the weather maps in mid-January — and called their brokers.

What they saw was a cold wave — a mountain of cold over Canada which would be pushed by persistent northwest winds into even the southernmost states of the U.S. A "big freeze" — maybe even a new record for cold in Florida — looked inevitable.

According to the *Boston Herald American*, Mr. Leavitt and his associates in Bedford pooled their money and bought 20 orange juice contracts — a total of some 300,000 pounds of the stuff. When prices went up after the freeze, they might have gained as much as $100,000, said the *Herald American*; Mr. Leavitt had no comment.

School of Medicine, New Haven. — **Sam Rubinovitz**, Secretary, 3 Bowsar Rd., Lexington, Mass. 02173; **Greg Gentleman**, Assistant Secretary, 818 S. W. Ninth St., Des Moines, Iowa

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Nothing to rave about, but here's a small portion of news for this month: **Joseph Spracher** reports, "Our family has been in Dallas three years where I am working for Xerox in the Office Systems Division. I completed my M.S. in applied mathematical statistics at Rochester Institute of Technology in 1973 and am currently studying computer science at Southern Methodist University." . . . **John Sample** now is Senior Marketing Representative for Honeywell's Traffic Management Center which is concerned with traffic signal systems and the utilization of simulation techniques for transit optimization. [Have you noticed how *everybody* is trying to get into *my* business? — Ed.]

Newsbag blurbs: **Rudy Kalman**, now Director of the University of Florida's Center for Mathematical System Theory and Professor of Mathematical System Theory at Eidgenossische Technische Hochschule in Zurich, was awarded the Oldenburger Medal by the American Society of Mechanical Engineers. It comes to Rudy for his development of time-domain filtering techniques and concepts of controlability and observability fundamental to the analysis and design of optimal control systems. I should note that this is only one of a number of such honors received by Rudy over the last decade or so; he, his wife, and two children maintain permanent residence in Zurich. . . . Recently, M.I.T. Corporate Leadership Awards were conferred (at the elegant Starlight Roof of the Waldorf-Astoria) on its alumni who are chairmen, vice chairmen, presidents, or managing partners of many of the leading business and industrial organizations in the United States. (P.S. Please, no comments; the above wording is M.I.T's, not mine.) Among the 152, two of our classmates garnered the award — and silver bowl: **Richard Simmons**, President, Allegheny Ludlum Steel Corp., Pittsburgh, Penn., and **Franklin Jarman**, Chairman and Chief Executive Officer, GENESCO Inc., Nashville, Tenn.

That's all, folks. — **Martin Wohl**, Secretary, 7520 Carriage Ln., Pittsburgh, Penn. 15221

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Thomas R. Williams is a recent recipient of M.I.T.'s Corporate Leadership Award, presented "to recognize the significance of creative and effective leadership in business and industry in our national life and the role of the private enterprise system in our national character and well being." Tom, as Chairman of the Board of the First National Bank of Atlanta, may well be interested in **George Perry**'s commentary on the state of the economy, the budget, tax policy, and capital information as presented to a group of Wall Street executives and economists in December. George, a Brookings Institution economist and collegaue of President Carter's newly designated head of the Council of Economic Advisers, left many of the group disappointed with his economic growth projections and suggested tax program. As **Dean Jacoby** aptly notes, "George still enjoys shaking up the establishment."

Eric Laimins is a Vice President at Hottinger Baldwin Measurements, Inc., Natick, Mass., after serving 20 years as Chief Transducer Engineer with BLH Electronics, Inc. . . . **Theodore Knowles, Jr.** is looking forward to our 25th Reunion. (How about the rest of you?) Since 1974 Ted has been a partner in Baumer and Knowles, consulting engineers, and is married with four children (two in college).

Dr. **Philip S. Rane** is practicing medicine in Danvers, Mass., specializing in Radiology, Nuclear Medicine, and Ultrasound. . . . Colonel **Hank Hirsch** was promoted to "full" professor at the University of Kentucky College of Medicine. Hank writes, "So far, the administration hasn't said just what it is that I am supposed to be full of, but they assure me that I have enough of it to qualify. Let's hope they're referring to wisdom." — **Dave Howes**, Secretary, Box 66, Carlisle, Mass. 01741; Assistant Secretaries: **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02090; **Lou Mahoney**, 6 Danby Rd., Stoneham, Mass. 02180

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News is rather sparse this month. The winter snows must have blocked your mailbox. Now is the time to get out and send us a letter.

The Institute presented awards to two classmates in a ceremony at the Waldorf Astoria last December. Howard Johnson conferred Corporate Leadership Awards on **David K. Easlick**, President of Michigan Bell Telephone Co., and **Robert L. Gibson**, President and Chief Executive Officer of California Canners and Growers. The award honors individuals whose responsibilities in private industry mark them as exceptional contributors to the strength and well-being of the nation.

Stanford Amstutz is the Vice President of development for Comshare, Inc., which provides timesharing and remote computer services. He and his wife Carolyn have two children — Jenny, 8, and Betsy, 6. . . . **A. C. DePrez** was appointed Vice President and Director of Licensing of Halcon International, Inc. Earlier he was Vice President, European sales, of a Halcon subsidiary. . . . **Dell Lanier Venarde** reports that she is a part-time student at Delaware Tech, and that last year she had a splendid hike through Norway, coupled to a visit to London and Copenhagen. — Class secretaries: **Marc S. Gross**, 3 Franklin Ct., Ardsley, N.Y. 10502; **Allan C. Schell**, 19 Wedgemere Ave., Winchester, Mass. 01890

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Reunion! Reunion! Planning for the 20th Class Reunion on June 10-12 is in full swing.

The response so far is very encouraging; over 75 classmates, most with spouse and many with children, are definitely planning to attend. Expect to see **Hank Salzhauer, Fred Morefield, Mal Jones, Dick Baird, Paul Carr, Bob Root, Peter Samton, Pierre Cathou, Jules Byron, Joe Kobus, Gaetano Carbone** and many other.

This promises to be the largest class reunion to date. The M.I.T. location is an added attraction and helps keep costs down. The reunion committee with **Paul Nicholson,** Chairman; **Jim Cunningham, John Christian, Art Aznavorian, Allen Burgess, Phil Cheney, Bill Doughty, Bob Batchelder, Ed Roberts, Hugo Liepmann, Ron Keefe,** and **Jack Currie** is devoting much time and thought to make this program interesting. The Boston Harbor Cruise/Clambake with historian, Edward Rowe Snow, is one of several key events. Classmates are urged to make an early decision to help the committee complete its plans.

A follow-up letter will give further details of this exciting reunion program. — **Paul Nicholson**, Reunion Chairman, 209 Governors Rd., W. Quincy, Mass. (617-472-8099 or 258-1394 during the day)

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As old Satch Paige, a baseball pitcher of indeterminate age, would say when asked to explain the secret of his long-lived career, "Jes' keep movin', don't look back, something might be gaining on you." Well, just take a peek and you'll see that spring is right around the corner and our 20th Class Reunion is creeping up on us. It is only a little over a year away so mark June 9-11, 1978 on your calendar now.

To help the Committee plan, we would like to know whether you would prefer to have the reunion held on-campus or at a location similar to Harbor View on Martha's Vineyard where we held our 15th Reunion. For on-campus reunions, M.I.T. provides free housing in the dormitories. Let me have your views by writing to me at the address below. (Send along some news for this column, too.) Or, call me at my Boston office, 227-4337, or at home, 262-0596.

Now we bring you the news. **Charles Diebold** was among the 152 recipients of an M.I.T. Corporate Leadership Award in December. This award is in recognition of outstanding achievements of M.I.T. alumni as leaders of business and industry. He is Chairman and President of the Western New York Savings Bank in Buffalo and has been very active in alumni affairs. . . . **Burton Figler** is a principal engineer with Aerodyne Research, Inc. in Bedford and is living in Winthrop. He has been extremely active in the United Way of Massachusetts Bay fund drives as well as in other public service causes. . . . **Bob Slott** is now Manager of Shell Development's Biological Science Research Center in Modesto and living in Stockton, Calif.

Frederick Gray recently presented a paper on air transportation propulsion improvements with advanced controls at the 1976 S.A.E. meeting in New York. He is working for McDonnell-Douglass on the West Coast. . . . **Ernst Weglein** is Manager of Process Engineering at Malden Mills, a manufacturer of pile fabrics, and is also doing some metallurgical consulting work. . . . For the past 11 years, **Emmanuel Landsman** has been a staff member at Lincoln Laboratory working on power systems design and construction for experimental satellites. Recently, he presented a talk on switching regulator circuits to the Boston I.E.E.E. . . . An intriguing note form **Arthur Zimmet**: "I am looking for interested alumni to join in founding a group to innovate in the medical field. Own a piece of your imagination!"

Bernie Schneiderman writes from Hawaii: "After living here for the past six years, we've decided we like it enough to stay. I've left my Washington-based company and am doing Naval Analysis for the Commander, Third Fleet at Pearl Harbor. If any of you come to the islands, look us up." . . . Another letter, this one from **Toby Carlson**: "I am continuing as Associate Professor of Meteorology at Penn State University. Recently, I attended a symposium on atmospheric radiation in Garmisch, Germany. We will be performing another concert on early instruments at the annual Madrigal Dinners in State College this year." . . . **Daryl Wyckoff**'s new book, *Railroad Management*, was published this past summer. In addition, Daryl writes that he is "on the board of Victoria Station's Restaurants, which has little to do with my railroad interests."

A note from **Greg Lazarchik**: "I have just been promoted to Business Manager of Organic Chemicals at PPG Industries Chemical Division. I am interested in finding some photos of the 1957 or 1958 varsity crews and would like to know if anyone has any negatives or prints that I can copy. Ann and I and our four children live at 210 Seneca Dr., Pittsburgh. If any classmates are visiting the area, please look us up."

That's all for this month. Places to visit, people to write, photos to swap, polls to take — it's all here in this month's news! Pass the word and keep movin'. — **Michael E. Brose**, Secretary, 30 Dartmouth St., Boston, Mass. 02116

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The end-of-the-year mailbag brought many notes from classmates. **Ernest Kirwan** is a member of the Board of Trustees of the Rhode Island School of Design. **Carlton Gebhart**, who was Assistant Dean of Students at Illinois Institute of Technology, has recently joined the Joslyn Manfacturing Co. in Chicago as Senior Project Engineer in the Hardware Division. **William Butcher** was named Manager of Plant Design and Construction for Suburban Propane Gas in New Jersey. **Jack Dominitz** was appointed Associate Technical Director of a new division at MITRE. **Neil Bernstein** was appointed General Manager of the Valpey-Fischer Division of Valtec, which produces piezoelectric crystals and transducers, in Hopkinton, Mass.

Roger Travis, President of Medi, Inc., a manufacturer of disposable medical products in Holbrook, Mass., has been elected President of the Smaller Business Association of New England. After completing his Ph.D. at M.I.T. in metallurgy, Roger listened to the advice in "The Graduate" — plastics!

James Brown and his wife, Dot, announced the arrival this past fall of a son, Nathaniel. Perhaps Nathaniel and his two sisters will continue the family tradition at M.I.T. as both their grandfathers are alumni, Harold Brown, '30, and John Swanton, '31.

From our worldwide secretariat: **Adul Pinsuvana** has moved from Bangkok to Jakarta, Indonesia, where he will serve as administrative officer of the ASEAN Secretariat. Adul did not indicate whether or not we should change the site of the 20th from Bangkok to Jakarta!

Phil Richardson sent word from New York that in the midst of last fall's election campaign, he met **Bert Lapidus**, a fellow campaign worker (their Assemblyman candidate did not make it) among 92 M.I.T. alumni in the district. Phil continues an active travel schedule between New York and Salt Lake City, taking time out for periodic lunches with **Scott Latimer**, who is still with Asarco, and some telephoning to classmates. He noted that **Herb Kempe**, living in the far reaches of New Jersey, is working as a stock analyst with the Tsai group. He also sent along a letter from **Jerry Schooler**, in London, who was recently awarded the Gold Medal insignia of the Club Oenologique for serving as a member judge in the International Wine and Spirit Competition! Jerry writes and lectures on management and corporate planning topics at the School of Business Studies at the City of London Polytechnic.

Some of the break in the continuity of this column is my own fault, celebrating one further stage in the transition from metallurgy by being admitted to the Massachusetts Bar — but they did not serve any wine!

Let us hear from more of you. It only takes a short note to **Phil Richardson**, 180 Riverside Dr., New York, N.Y., 10024; **John Amrein**, 770 Greenwood Ave., Glencoe, Ill., 60022; **Adul Pinsuvana**, ASEAN Secretariat, 6 Jalan Taman Pejambon, Jakarta, Indonesia; **Bob Muh**, 907 Chantilly Rd., Los Angeles, Calif., 90024; or myself, **Allan Bufford**, 8 Whitney Rd., Newtonville, Mass., 02160

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And now, the information you've all been waiting for — this month's center of gravity is Elmer, Mo., give or take a few miles.

Dave Powell reports that he is currently an associate professor at Stanford University, with a joint appointment in the aeronautics/astronautics and mechanical engineering departments. He is teaching courses in digital control and dynamics, and he is conducting research on automotive engine control. . . . **Joseph Goldstein** has been named Theodore L. Diamond Distinguished Professor in Metallurgy by Lehigh University. Joe has been on the faculty since 1968 and has published over 70 papers, as well as a book. His research areas are solid state diffusion, diffusion-controlled transformations, and electron microscope applications. . . . **Robert McClatchey** has been honored by his colleagues at the Air Force Geophysics Laboratory, winning the 1976 Guenter Loeser Memorial Award for his research in atmospheric transmission of visible and infrared radiation.

Donald Sipos is now Vice President of SGL Piping Systems, with whom he has been associated for the past seven years. His wife, Cynthia, is active in church work. Their son, Peter (17), is planning to study architecture in the fall, and their daughter, Pamela (15), is interested in music and sports. Don writes that he heard from Marge and **Bob Keeney**, whose family also is "pretty well grownup." . . . **Larry Martin**, his wife, Marian, and their sons, Nicholas, and Gregory, recently have moved to a new house in Malibu, where they have a great view of the ocean and sea life, including migrating whales. Larry is with Xonics, Inc., which is near the Los Angeles airport, and he invites friends to contact him when in the Los Angeles area. — **Robert F. Stengel**, Secretary, 152 Oxbow Rd., Wayland, Mass. 01778

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Most of the news you people send me is good. For example it is usually related to matters of promotions, births, new publications, and so on. No one ever sends me any bad news, which can be deflating to a sensitive ego such as mine. So I am delighted to share the following news with you: **Mordecl Bandersnatch** (who was kicked out in December of '59 for dope smuggling) is serving time at Sing Sing these days. His hopes of being let off for good behavior were dashed last fall when the prostitution ring he had formed was discovered by the authorities. . . .**Jack Armstrong**, who we all thought would become President of the U.S. before he was 45, is now enmeshed in the problems of his third divorce. Jack writes, "The thought of three alimony checks going out each month is most depressing. I had thought that marrying the Boss's daughter this last time would have solved my problems. Unfortunately my father-in-law's business of solid gold horse shoes in limited editions has gone bust and he is suing me too. I guess that this all reduces my chances for elective office. In my last attempt I lost by a factor of ten in my attempt to become Commissioner of Public Works in East Overshoe, Idaho."

Foureyes Weenie writes that his attempts to publish an article describing his thesis research have been defeated again. The Reviewers are accusing him of outright dishonesty this time.

That's Susan E. Schur, '60, with Robert G. Flannery, President of the Western Pacific Railroad Co., at Purdue University's main campus. Both were recruited by Purdue for a film on the different career directions taken by engineering graduates; costarring with them were Chester Ward, a sales engineer for Harbison-Walker who once played defensive backfield for the Pittsburgh Steelers, and Eugene A. Cerman, the last U.S. astronaut to walk on the moon who is now Executive Vice President — International of Coral Petroleum, Inc. Ms. Shur's career includes an advertising business, publication of a magazine (*Technology and Conservation*), and work as designer and painter.

Foureyes goes on: "I wasn't too surprised since my thesis committee laughed in my face during the thesis defense. My advisor claims that he doesn't know me and I am looking for a Rumanian journal with low standards in order to get a publication. It's publish or perish, you know. This may be my last letter to you." . . . **Al Gladhander** has had an interesting career, to say the least. Shortly after graduation Al joined Penn Central in order to insure a smooth merger of the two railroads. Since this did not go too well he joined the special forces to fight for freedom in Southeast Asia. Leaving this obscure area he then joined the Nixon White House to smooth congressional relations. Once this went bust he was hired by Lockheed for international sales. He doesn't say what his current position is, but I hear that it has something to do with peanut futures.

Now for some more upbeat letters. **Steve Salomon** writes "During this last year many exciting things have happened. Sherry and I traveled about five weeks all over Israel. It was a most emotional experience. Also, I received a Certificate of Achievement and a cash award from the U.S. Nuclear Regulatory Commission for my contributions to the Nuclear Energy Center Site Survey. Most recently I had the chance to consult at the Congessional Office of Technology as an expert on their survey of coastal effects of floating nuclear power reactors."

On the electoral front **Sue Kannenberg** writes that she is now President of the Association of M.I.T. Alumnae. . . . **Roy Waldheger** is now Vice President and General Manager of Carbon Technology, Inc., which is based in Slocum, R.I. . . . **Paul Thompson** is a pilot with Commercial, Instrument and Multi-engine ratings and owns his own Cessna 182. To pay for all this he works in Corporate Research and Planning for DBA Systems Inc. in Melbourne, Florida. And he has

become President of the local Civic Music Association.

Finally a letter from **Alan Cohen** (M.D.): "I am continuing to practice Neurology in Orange County, Calif., and am actively involved in performance of computerized axial tomography. I am also teaching at the University of California at Irvine Medical School and have recently been elected Vice Chief of Staff of the Los Alamitas General Hospital."

As you can see I like to have good news from you, but 'round about April 1 I would like to see a couple of rotten notes to flesh out the column. Good or bad, keep 'em coming. — **Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, Mass. 02167

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Charles G. Glueck, Jr., has been elected Assistant Vice President of New England Mutual Life Insurance Co. in Boston. He has research and planning responsibilities and is chairing a task force for special studies using the computer. . . . **Richard D. Spence**, President and Chief Operating Officer of Consolidated Rail Corp. in Philadelphia, was one of 152 alumni who received an M.I.T. Corporate Leadership Award in December. The awards honor individuals whose responsibilities in private industry mark them as exceptional contributors to the strength and well-being of the nation. . . . **J. Edward Anderson** is a founder and president of a new organization, The Advanced Transit Assoc.

James H. Knowles has been appointed Department Head at Bell Laboratories in Piscataway, N.J., where he is in charge of developing computer systems that control inventory and record monetary investment in plug-in equipment for central call-switching facilities. He is active in the Middletown Environmental Commission, where he and his wife Ruth Ann have lived for the past eight years. . . . **Joseph F. Vittek, Jr.,** has joined the faculty of the Franklin Pierce Law Center in Concord, N.H., as a professor of law. He was formerly an assistant professor at M.I.T. and Assistant Director for the Draper Laboratory. He and his family reside in Northfield. . . . **Lane Anderson** is an accomplished cellist with the Monte Carlo Quintet, which presented a program sponsored by the French-Speaking Assoc. of New England at the International Institute in Boston.

Herbert Selesnick was elected a vice president of Harbridge House, one of the largest multinational management consulting firms in the world. He will direct the firm's services in the areas of housing and relocation, neighborhood renewal, historic and architectural preservation, and social rehabilitation service. . . . **Raymond P. Wenig** publishes the *Minicomputer Applications Analyzer*, *The Minicomputer Software Quarterly* and seven technical guidebooks. He also runs 11 professional and management seminars and serves as a director of the "Minicomputer Users Group." He and his wife had a girl, Lydia Jane, last March.

Jeremy Alperin has been promoted to Assistant Professor of Otolaryngology at the Case Western Reserve University School of Medicine in Cleveland, Ohio. He received his M.D. from the University of Vermont. . . . **A.J. Giramonti** presented a paper on Combined-Cycle Power Systems done at the United Technologies Research Center in East Hartford, Conn., at a symposium in Hollywood, Fla. sponsored by the E.P.A.

Gordon W. Mann has been appointed Managing Director of WABCO Manufacturing S.A. in Gembloux, Belgium, serving markets in Europe, Africa, and the Middle East. He and his wife Gail have two children, Curt, 9, and Wendy, 8. . . . **Dave Stare** reports that alumni are always welcome at his Dry Creek Vineyard winery near Healdsburg, Calif.; six awards were won at the first Sonoma County wine judging.

Hard to believe but our 15th Reunion is coming up in June and **Bojey Salmon** writes that a Reunion Committee has been formed with **Terry Bray** serving as Chairman. By the time you read this you should have all received information from Bojey and the committee about the reunion to be held at Cape Cod on June 9 and 10. — **Jerry Katell**, Secretary, 7 Silverbit Ln, Rolling Hills Estates, Calif. 90274

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Georges Duval is living in Takoma Park, Md., with his wife Linda and three children. Linda is working very hard to support the family while Georges is in his second year of Medical School at George Washington University. The U.S. Navy is picking up the tab for Georges, schooling in return for a three-year stint as a medical officer after graduation and internship. . . . **K. E. Sahin** writes that after serving as chairman of the management science and information systems group in the business school at U. Mass, he is spending a year as visiting faculty at the Harvard School of Public Health. He continues his research on computer communication nets. The Sahin's third child was born in 1976. . . . Since January, 1976, **Ron Walter** has been viewing the New York City fiscal crisis even closer than from the vantage point of the Budget Bureau where he had been before. Ron has joined the City Hall staff as assistant to the mayor with major responsiblities in the welfare, health, and education areas. In the early summer Ron and his family will be moving to the new town on Roosevelt Island in the East River of New York City.

Mack Hamilton and Susie have been in Palos Verdes for years. They are now moving into a larger house that will give their two daughters adequate room for party giving. Mack has been playing soccer for a local men's league for several years and he enjoys the exercise. But, he writes, it does make Monday mornings a little rough since there are often aches and bruises left over from Sunday's game. . . . **Charlie Gardiner** did aerodynamics research for McDonnell Douglas Astronautics Co. from 1966. After being laid off last May, Charlie became active in the M.I.T. Club of Southern California. As one of the Club Vice Presidents he has worked on and attended many of the programs and activities. . . . **Bill Gadzuk** has received the Silver Medal of the Department of Commerce for services of unusual value to the Department, for his work at the National Bureau of Standards. Bill is a physicist in the Surface and Electron Physics Section — he has worked in the area of field and photoemission from clean surfaces and adsorbed species. . . . **Matthew Lind** has been appointed Acting Executive Director of the Pension Benefit Guaranty Corp. The appointment was announced by outgoing Secretary of Labor, W. J. Usery, who cited Matthew's ability to develop workable approaches for implementing the complex provisions of the plan termination insurance program. Prior to joining P.B.G.C., Matthew was with the Office of Management and Budget, MITRE and Addressograph-Multigraph. Matthew, his wife, Brenda, and daughter, Jessica, live in Washington, D.C. — **Mike Bertin**, Secretary, 18022 Gillman St. Irvine, Calif. 92715

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This month we've been lucky. We have two class heroes and a few alumni envelopes.

The first class hero is **Michael Averbach**. Michael wrote to tell us of his new position at Pfizer Inc. Central Research in Groton, Conn. He is Applications Laboratory Supervisor of the Industrial Chemicals Department. During his first week at Pfizer, Michael ran into Willard Welch, '65, also working there.

News of another classmate **William Young** also came from Michael. Bill, his wife and two children recently moved to a new home in Greenwich, Conn. Bill is a chemical securities analyst for Morgan, Stanley and Co., a N.Y.C Investment Banking outfit.

The second class hero we've heard from is **Leslie "Bud" Boring**. Bud has written to keep us posted on the banking news from the Middle East. He's wrapping up two-and-a-half years in Riyadh, Saudi Arabia, and he's anticipating a move to another Citibank assignment in the Mideast, this one likely to be in Egypt. In a minor lament of international mail service, Bud mentioned that his July/August *Technology Review* finally reached him around Christmas. Bud and Annie now have the company of their first child, Nicholas Eric, who was born in Paris, France last July. We can look forward to hearing from all three of them from Cairo, or perhaps Alexandria, or will it be Port Said? Good luck, Bud.

Now to news of some of our other classmates: **Markham Alpert** was promoted to full professor of Marketing at the University of Texas at Austin. His wife Judy is also at the University of Texas. She is a Teaching Assistant and Ph.D. candidate in Music Education. . . . **E. W. Casper** has moved to 10 Button Rd., Huntington, Conn. 06484. The Casper family is eagerly awaiting the birth of their second child. Congratualtions on all the good news! . . . **Alton B. Otis, Jr.** is currently Director of research and development for Xebec Systems, Inc. and also has his own mini and micro systems consulting business.

Last but not least, one of our classmates received the M.I.T. Corporate Leadership Award. He is **James Spiegel**, the president of Kayser-Roth Corp., New York, N.Y.

As for us, we are continuing to prosper and enjoy the ever-changing pleasures and challenges of growing children; the Washington area has been good to us. Keep the mail coming. Remember dear old M.I.T. — **Steve Schlosser**, Secretary, 11129 Deborah Dr., Potomac, Md. 20854

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Lots of tid-bits from the backs of Alumni Fund envelopes this month, plus some news clippings. There probably will not be enough room for any St. Bernard stories!

Bruce Golden spends his days practicing corporate and securities law as a partner of McDermott, Will and Emery, in Chicago. He has also started his own jazz-rock disco band "The Sounds of Now," which is available for "proms, homecomings, weddings, bar mitzvahs, etc." (presumably only those in or near Chicago). . . . Mr. and Mrs. **Eric Westerfeld** now have a second daughter, Sara. . . . A daughter, Sonja Christine, was born to the **Jon Hansons** in September. Jon continues to work for Hooker Chemical, most recently as Product Manager for the ElectroChemical Division in Niagra Falls, and is half-way through an M.B.A. program at S.U.N.Y.-Buffalo.

Dom Giovachino worked for R.C.A. in Lancaster, Penn., for nine years. In January, 1976, Dom, his wife Pat and daughters Monica and Jessica moved to the D.C. area. Dom is now working for Activity Systems, a small but growing producer of medical equipment, in Reston, Va. . . . **Art Bushkin** is working for a year as a Project Manager for the Privacy Protection Study Commission, and recently co-authored a book, *The Privacy Act of 1974: a Reference Manual for Compliance*. Kathy Bushkin is Press Secretary for Colorado Senator Gary Hart. . . . Also in the D.C. area is **Charles Gholz**, who has recently formed a law firm specializing in patent, trademark and copyright law, with offices in Arlington, Va., and Wilmington, Del.

Peter Gerstenberger, who stayed at the 'tute for master's and doctoral degrees in management, was a research associate at M.I.T., Senior Consultant at Arthur D. Little, President of DKG Assoc. and a project engineer with Litton Industries. He has recently been named a director of The Berwick Group, management consultants. . . . **Anthony Slusarz** was recently designated a Fellow of the Society of Actuaries. Anthony has a law degree from the University of Connecticut and is a senior actuarial assistant at Aetna Life and Casualty.

Po-Chiu Mar is currently representative director of AMF in Yokohama, Japan. . . **David Barber**, who helped found Enterex, Inc., in 1968,

has returned to the data entry system firm as vice president of sales. . . .Another Georgian is **William Kirby**, who is presently President of Crest Finishers, a carpet-dying firm, and of Charter Carpet Corp., a carpet manufacturer.

That's it for now. Hope this column finds us all somewhat thawed out after a long hard winter. keep those cards and letters coming. — **Edward P. Hoffer**, M.D., Secretary, 12 Upland Rd., Wellesley, Mass. 02181

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Not a bad supply of news this month. **Hank Perritt** has joined Consolidated Rail Corp. (Conrail) as Assistant to the Chairman. He will direct a series of analytical studies for Conrail, as well as coordinate the direction of Conrail's subsidiary companies with relation to the corporation as a whole. He's been in Washington since 1971 in a variety of posts. Hank previously was Deputy Under Secretary for Economic Policy Review in the Department of Labor. Prior to that Hank joined Lockheed-Georgia after getting a law degree from Georgetown. . . . Union College announced that **Dave Hayes** has joined their chemical department as an assistant professor where he will work on determining the mechanism of enzyme catalysis using theoretical methods. . . . Camp Dresser & McKee Inc., a Boston-based environmental consulting firm, named **Bill Sommerfeld** as director of management information services. Bill's responsiblities will include the direction of all of CDM's computer services and facilities.

Marvin Sirbu is still working as a research associate at the Center for Policy Alternatives at the Institute. Marvin writes that "one current project is looking at the job market for engineers and scientists. I am also teaching a case-study seminar in the Technology and Policy Program. In my spare time I've been building furniture in the hobby shop." . . . **Stan Horowitz** reports that he is "happily working in quasi-academia trying to solve the problems of the Navy for the Center for Naval Analyses. My wife is struggling to give away money for the N.S.F." . . . **Joe Adolph** finished his sixth-year residency at Georgetown University Hospital. He and his wife, Nancy, and their 3-year-old son moved back to New England where he has started a urology practice in Marlboro and Framingham. . . . **Mike Feldstein** currently is the manager of Storage Products engineering with Data General Corp. . . . **Ken Dritz** writes that he "has been with Argonne National Lab since Tech days where, for the past two years, I have participated in research in program transformation systems. This work led to a six-week trip to Moscow this year to study related work and plan future cooperation. In other news, my long-term project to photograph all the wildflowers of the Chicago region continues strong with 600 species behind me now."

Finally, **Rex Ross** reports that he and Adrian welcomed a second son, Brian Turner, on December 10, joining their 3-year-old son, Rusty. The Ross' are still in Houston where Rex is reacquainting himself with the "joys of golf." Yours truly fully understands these "joys." Rex has been with Geoquest International, an oil and gas consulting firm, as vice president since 1975.

I am off for a four week-vacation to Australia, New Guinea and New Zealand where I plan to play a lot of golf and see the beautiful sites. Assuming I make it back, I will report on the trip in the next issue. — **Paul Rudovsky**, Secretary, 340 East 64 St., Apt. 10B, New York, N.Y. 10021

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Try to attend our ten-year reunion June 9-12 at M.I.T. For those classmates in California who will be unable to return to Boston, a mini-reunion may be held somewhere in the San Francisco Bay Area. Anyone who has any bright ideas concerning such a mini-reunion or who wishes to help in some way should contact me at (415) 820-0971 or 834-4820. The computer listing for our class indicates that approximately 125 classmates live in California, about half of whom are in the San Francisco Bay Area.

Ed Geltman is doing a cardiology fellowship at Barnes Hospital in St. Louis. . . .**Bruce Ressler** pedaled 1,500 miles through Eastern Europe on his old Cambridge pothole-jumping ten-speed bike. He and eight others took a slow, beautiful route from Warsaw through southern Poland, Czechoslovakia, Hungary, Romania and Bulgaria. After a week on a small Greek island, Bruce returned to his job at U.S. Department of Transportation in Cambridge. . . . **Harold Granek** graduated from University of Miami Medical School last June. He is an internal medicine intern at Jewish Hospital in St. Louis. . . . During 1975-76 **Alan Hausrath**, on leave from the University of Pittsburgh, studied mathematics as it is taught at the pre-college level. This involved two summers of course work at Washington State University and a year in the public schools of Sunnyside, Wash., a small town in the heart of the agricultural Yakima Valley. Al observed, and taught two classes of Spanish speaking children whose parents are migrant laborers from Mexico. His wife, Anne, was the resource room teacher in Sunnyside Junior High, and during the spring they taught night classes together in an adult basic education program for young Spanish speaking adults. Al writes: "In retrospect, 1975-76 was one of the pivotal years of my life. I now have a new conception of the role of mathematics and the mathematician in society; I am more or less fluent in another language; and I have some ideas of what can and should be done at the pre-college level and how to go about it." Last summer Al resigned his position at Pitt and accepted a new one at Boise State University in Idaho.

Bob Howard, who lives in the Miami area, came to San Francisco in early January to visit friends and conduct business. He recently left Lang Engineering to organize Florida Consulting Group, which will specialize in software design. During Bob's stay we had a very pleasant dinner at the home of Sheri and **Dave Espar,** who have their first child, Michael, a most bouncy boy. Dave is a producer/director at Veriation Films in Palo Alto. I especially enjoyed seeing a public relations film that Dave made a few years ago for M.I.T. Bob provided me with the remainder of the news in this column. . . . **Mike Telson** took a leave of absence from his Washinton position to spend three months in Venezuela as an energy adviser. . . . **Lou Offen** finished his neurology residency in Miami. He moved to Rockville, Md., in June and now has several offices in the Maryland suburbs of Washington. He and Laura were married in November, 1975. . . . Carol and **Rich Bronowitz** and their two daughters also recently moved to the Maryland suburbs of Washington. Rich is a systems analyst for the Navy. . . . **Mike Sussman** lives in Pittsburg and works for Westinghouse. . . . **Steve Alter** was recently in Miami to give a paper on futurology. He had an article published in the December *Harvard Business Review.* Steve is an assistant professor at the University of Southern California Business School. . . . Last fall Ellen and **Jeff Shapiro** visited Marty Levin in Brussels. Marty, who failed to receive his M.I.T. degree because he did not finish his last semester, is a partner in a European company specializing in software systems for medical applications. — **Jim Swanson,** Secretary, 669 Glen Rd., Danville, Calif. 94526

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Like every place else in the East, Washington is in the middle of its coldest winter in a long time. It probably shouldn't bother us, coming from Beantown, never the less we do remember being able to go sailing here in past winters and hope that conditions here come back to what's expected from south of the Mason-Dixon line.

Something suddenly moved **Jon Lehr** to write us for the first time in eight years, and to commend him for his effort and encourage others to come out of the woodwork, we shall print his concise letter in its entirety: "1. Attended Columbia Law School after graduation from M.I.T. 2. Grew shoulder length hair and a full beard. 3. Busted at Columbia in 1970 ("legal" observer at a Cambodia demonstration.) 4. Charges dismissed. 5. Got engaged to, and subsequently married, Nancy Pierpont (Barnard '71) with whom I was busted. 6. Got a haircut and shaved off beard. 7. Spent over three years as a real estate attorney with New York firm of Kaye, Scholer, Fiermann, Hays, and Handler. 8. Bought a house in Scarsdale and fathered a son, Donald Pierpont Lehr, now 2. 9. Presently working as a real estate attorney for the firm of Battle, Fowler, Lidstone, Jaffin, Pierce, & Kheel in New York."

We have two births to report this month. First, **Mike Krashinsky** reports the birth of his second son, Paul, on May 20, 1976. He reports that "life with two children is much more complicated than life with one." Otherwise he is working hard on his own research on the economics of day care and generally enjoying life in Toronto . . . Sandy and **Rich Adelstein** report the birth of Rachel Louise on September 3, 1976 and are all doing well, "if a bit harried." Rich is now an assistant professor of economics at Wesleyan and a visiting fellow at Yale. . . . We also have two new degrees to report. **Bob Shull** just received his Ph.D. in Metallurgy at the University of Illinois and when last heard from was job hunting . . . In May, 1976, **Gordon Logan** received an M.B.A. with honors from Wharton in Finance and Multinational Enterprise. He is now senior consultant with Price Waterhouse & Co., management advisory services in Houston. . . . From Ann Arbor we hear that **Art Cole** is still working away on his doctorate. However, his wife, Joanne '71, has been able to finish a master's in mechanical engineering and is now gainfully employed in Ford's Heavy Truck Division.

Back in Cambridge, **Carl Martland** is a research engineer at M.I.T.'s Center for Transportation Studies where he is working to improve rail freight service and freight car utilization and is also playing intramural basketball. . . . **Richard Ehrenkranz** is a fellow in perinatal medicine in the Yale University Medical School's Pediatrics Department. He is living in Guilford, Conn, in a 150-year-old house which they have renovated so that it has a contemporary interior. . . . That's all the news we have this month. Keep those cards and letters coming, and drop us a line if you would like to work on the reunion committee. — **Gail** and **Mike Marcus**, Secretaries, 2207 Reddfield Dr., Falls Church, Va. 22043

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Rik Anderson reports that he is in the process of moving from a position in the United Airlines Engineering Department to a job as a United Fleet planner in Chicago.

Edward E. Barr and **Rowland C.W. Brown** received the M.I.T. Corporate Leadership Award on December 3, 1976, in New York. The awards are intended to recognize those M.I.T. alumni who have furthered what the M.I.T. Corporation perceives to be the public interest by the responsible, exemplary conduct of corporate, private enterprise. Mr. Barr is President of Sun Chemical of New York and Mr. Brown is President of Buckeye International of Columbus, Ohio. Also receiving the awards were top executives of Grumman Corp., Texaco, American Smelting and Refining, Kennecott Copper, Yates Petroleum, Western Electric, Caltex Petroleum, American Electric Power, Firestone Tire and Rubber, and White Motor.

Dave Erickson reports he and his wife have finished a year's tour of the nation in a converted van. They are now in the Boston area and looking for a home in New Hampshire or Maine.

Captain **Thomas Imrich** has left active duty with the United States Air Force Dynamics Lab at Wright-Patterson A.F.B. for a job with the F.A.A. in Washington. He is on the advanced concepts staff of the systems engineering management office. Tom is an F.A.A. H.Q. pilot and recently received DC-10 and Turboject Flight Engineer ratings.

Peter Kleeman plans to complete a doctorate of philosophy in environmental engineering at Harvard this year. . . . **Linda Kuhnen** is reported living happily with her husband Carl in Houston. Linda is qualifying as a tax accountant and Carl is an exploration geophysicist seeking oil for Allied Chemical. . . . **Don J. Lapenas** is on the faculty of the University of Pittsburgh's Medical School in the Department of Pathology. He is interested in pathological anatomy and nephropathology.

Steven M. Maser (Ph.D., University of Rochester, 1974) is on the Political Science faculty at the University of Wisconsin at Milwaukee. Steve is chairman of the local M.I.T. Alumni Fund Drive. He reports that about two years ago he lost his brass rat while camping in Nova Scotia. Recently he received the ring back from a kind soul in Pictou, a French fishing village, who traced Steve through the Institute. Moral: It pays to let the Alumni Office know where you are.

Stephen D. Osheroff works for T.R.W. in a manufacturing environment. He would welcome calls or visits from othe M.I.T. alumni who are not already active in the M.I.T. Club of Princeton.

Steve Poppe has done the following since leaving M.I.T.: two years at Rockwell International's Autonetics Group in Los Angeles; one year at Hoffkan Electronics, also in the L.A. area; thence to Berkeley in O.R.; two summers at RAND. His thesis area is now production planning and he has an advisor who was graduated from Sloan.

Michael Rodriguez is engaged in neurophysiological research at the center of the cyclone, presumably somewhere on the same planet as the center of the universe (a.k.a. the Hub). . . . **Tom Scholz** is, according to a U.P.I. report in the *New Britain Herald*, the brainchild behind "Boston," one of the latest sensations on the hard rock scene.

John L. Usher writes that he remains Ph.D.less in the growing Fusion Technology Program at Brookhaven National Lab. . . .**Weldon W. Wilkening** earned his Sc.D. in Metallurgy and Materials Sciences in June. He is a post-doc in the Mechanical Engineering Dept. at M.I.T. and lives with his wife and three children in Watertown. — **Peter Peckarsky**, Secretary, 950 25th St., N.W., Washington, D.C. 20037

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During the Christmas holidays I received a call from **Del Knarr**, famous leader of the aborted sanctuary ouster attempt. Del is working for T.R.W. Systems, living the life of a crazy Californian. He's looking for a new position where people will pay him what he is worth. Del can be reached at 615 Esplanade, #109, Redondo Beach, Calif. 90277. Del asked for the address of **Cliff Ananian** and would like to hear from him. I'll second the request for a letter from Cliff, who was the nefarious Amenian of the Delt house. He made the same request for **George Hustak,** Polish powerbroker and lacrosse afficionado, which I also second.

Bruce Smith is married to Ellen (University of California at Berkeley, '71), and has a 9-month-old daughter born in March. Bruce received a Master's from Stanford in mechanical engineering, has worked two years at Bechtel Power Corp. in L.A., returned to Boston to completed his M.B.A. at Harvard Business School, and is now working in the Rate Department at Detroit Edison. He also comments that if you want your gift to be deposited in the Kent State Memorial Fund, it should be so designated. If any of you have not designated your gift this way in the past, but meant to, I suggest you write the Alumni Fund office to see what you can do about it.

Thomas Sico will be graduated from Ohio State University College of Law in June and is now a professional gambler. He has been to the Bahamas a few times with outstanding success (50 per cent returns) on the blackjack tables, credits Ed Thorp's *Beat the Dealer* and some luck. . . . **Ashok B. Boghani** is working as program manager of Foster-Miller Associates, and was awarded the N.A.S.A. Certificate of Recognition for research in air cushion landing systems.

R.M. Kwasnick is an attorney in Boston with the firm of Guterman, Horvitz, Rubin and Redman, living in Brookline; his wife, Susan, is an art teacher in Newton and a free-lance artist. . . . **James L. DeLucas** is still attending medical school at the University of Alabama and will be graduated in June, 1978; his wife, Emma, gave birth to a boy, Lawrence John on October 10, 1976.

John Morgan became an ordained minister in the United Church of Christ after attending seminary for three years at Bangor Theological Seminary. He served two years in Portland, Maine, in a church; John and Barbara have returned home to Shelton, Conn., and John is serving the church there. They have two children, Cheryl, age 3 and Douglas, age 14 months. For relaxation in his spare time, John spends his time "tooling" over a musty Tech math book. John and Barbara send best wishes and greetings to all their friends.

I apologize when information reported here isn't complete. The best way to make sure the notices in this column are complete is to send me a letter. The notes are edited when they are too lengthy, but if I get letters throughout the year rather than just information on the backs of Alumni Fund envelopes, I can try to space things out.

My partners and I are renovating an old building and plan to move into it by March. If you are by Brenham (which is an unlikely possibility for most people) please stop by. — **Hal Moorman**, Secretary, P.O. Box 1808, Brenham, Tex. 77833

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Dick King writes, "I am now living in Iseling, N.J., with my wife and two-year-old daughter. I recently started a new job with Teletest, a small, sophisticated software consultant house in New York City. I participate in community activities including acting as a member of the M.I.T. Educational Council in my area. . . . From **Jeff Cooper**: "I have started an acoustical consulting firm that specializes in designing recording studios. It has been very successful, and in the past year I have done studios in Europe and Mexico as well as the U.S. Some of the 'names' I have done studios for are Chicago, America, and Jose Feliciano. The company supplies the architectural and acoustical blueprints as well as supervising construction and all interfaces with recording equipment." . . . **Simon Wieczner** is back at M.I.T. and expects a Master's degree from the Sloan School in June. . . . **Alan Graham** is the co-author of a new book, *Introduction to Urban Dynamics*. He is working as a research assistant in Professor Jay Forrester's group.

Mark Haberman writes, "I am in the Ph.D. program here at the University of Wisconsin. I arrived here via an unusual route — a course XXI concentration in philosophy, a year's work in a psychiatric hospital, an S.B. in course VII, an S.M. in course XX, and failure to get into medical school (1972-75). Then, after some hard thinking, I chose the equally onerous field of clinical psychology and got in. I couldn't be happier in this field which should combine hard-nosed research with soft-hearted clinical work, but doesn't."

As for me, I took a leave of absence from General Electric and am now in the Master's program at Sloan. My successor at G.E. turned out to be **Dan Silber**, who got his Master's in mechanical engineering from the Institute last year. — **Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

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Due to several pleasant surprises while I was visiting the Institute, and some phone calls while I was in Manhattan, I have plenty of news! But if more of you wrote, we would have even more.

While in New York, I visited with **Michael Steckler**. Mike is a graduate student at Lamont, Columbia's graduate school of Oceanography. He has the best of both worlds, in that he lives on West 113 St. in Manhattan, but his classes take place at the lovely, secluded Lamont estate, 30 minutes outside the city. Most of the 23-acre estate is carefully preserved woods, withing which Mike has found it very pleasant to stroll. . . . **Carol Steiner** is working for Cornell as a researcher and is in the process of applying to graduate school for chemical engineering. This makes another wise defection from Course V in which Carol took her degree. Carol likes Cornell, and enjoys getting a pay check for her efforts.

Joe Abeles is doing graduate work in physics at Princeton. I did not, unfortunately, have an opportunity to catch him ice-skating at Rockefeller Center. He told me he has been doing some skating at Princeton, as well as a lot of hard work.

While visiting the Institute, I bumped into a couple of classmates, all in one day. **Wendy Peikes** was in from California where she works for Hewlett-Packard in the same division as an another classmate, **Jim Banks**. Apparently, working for H-P is quite agreeable, for they are sending Wendy part-time to Stanford for an S.M. . . . Also, I saw **Sue Burkhardt**, who is a graduate student at Stanford. She likes the weather and the work, which she confided is easier than at the 'Tute. Apparently, **Mee J. Kang** is studying civil enigneering there, and is enjoying it also. In addition, Sue informed me that the following classmates are at Stanford: **Robert Oldshaker, Linda Yester, Rob Shultz**, and **Paul Fried**.

Raphael Blumkin was in Cambridge over the Christmas vacation doing some consulting work. He is at Cornell Business School otherwise. He found that his background in Course VII required him to do a lot of catching-up. However, he was successful, as evidenced by his landing a consulting job after one semester. He enjoys living in an apartment of his own, and had visions at the time I saw him of getting a car. It appears that Ithaca is quite cold and Raphael is quite tired of freezing while going to school.

I also saw **Michael Rucker, Todd White,** and **Ruth Cross**. In the rushed circumstances of meeting them, I only managed to get substantial details from Michael. Mike was working for Schlumberger, and he quit! He found that his Herculean labors were not appreciated sufficiently. He is now wiser for the heroic efforts involved, especially while he was working on oil rigs in West Texas and California. However, he did say he learned a lot of techniques while working for Schlumberger. When I saw him, he was looking for work involving instrumentation with/on rocks, which is considerably less hazardous than ice-coated drilling platforms.

Todd briefly mentioned that he is now married, to his high school sweetheart, and has changed his name. Unfortunately, due to the rush, I couldn't get his new name, except for the fact that it is his wife's last name — White. Todd, if you would please tell me what your name is in a letter, I shall cheerfully make amends.

As for Ruth, I am afraid I just met her and did not have a chance to speak with her. Sorry about that. But she appears to be in good health, which is at least something I can report.

Zachary Levine, came up from the University of Pennsylvania for the holidays. He is studying solid state physics. He has one major complaint about the school. They are keeping him too busy to do any research. Too many exams and courses make for little research, or sleep either, for that matter!

Lastly, I got a letter from **Curtis Menyuk** who is at U.C.L.A. studying physics, and in particular, cosmology. He writes that he is doing well, but that he is "alone, isolated, utterly by myself — leading a monastic, ascetic existence." At least he is getting some exercise, for he tells me he has to bicycle four miles to get to school. If there are any other '76ers at U.C.L.A., do look up Curtis! I think he would enjoy it.

So much for the news this time. How about a few letters, to give some relief to your weary secretary's feet as he pounds the pavement of Cambridge occasionally to seek news. My feet would really appreciate it. — **Arthur J. Carp**, Secretary, 67 Badger Cir., Milton, Mass. 02186

M.I.T. Named Sea Grant College; Completes its "Conceptual Horizon" (For the Time Being)

The Institute's Sea Grant Program was recognized last January by being named the nation's 12th "Sea Grant College," and the first private institution so named. The designation by the Office of Sea Grant in the National Oceanic and Atmospheric Administration, represents both an honor and an opportunity for the Institute. The designation is afforded only to those institutions meeting the strictest requirements for excellence and scope in their Sea Grant research and education. It also confirms a continuing commitment of the national Sea Grant Office to the designated institution. Last year the M.I.T. Sea Grant program received $1.1 million from the national office, which was matched by $780,000 of combined support from the Henry L. and Grace Doherty Charitable Foundation Inc. — a longtime Sea Grant supporter — as well as numerous other industrial groups, regional agencies and cooperating institutions.

The Institute was named to Sea Grant College status for such accomplishments as its Institute-industry advisory service to develop ocean-related business; its studies of the environmental and economic impact of offshore oil; its computer models of oil spill likelihood and movement, and its development of improved fishing gear.

Current projects range widely, from studies of ocean wave energy systems to development of underwater welding and cutting techniques and improved oil spill detection and cleanup methods. Sea Grant scientists are also studying New England's "red tides," methods for managing New England fishing resources, rates of coastal erosion and sediment deposition, utilization of fishing wastes, and the nutritional content of seafood.

"I believe it's not an exaggeration to say that the nations of the world have entered a new age — the era of the useable ocean," said President Jerome Wiesner at a ceremony marking the Sea Grant College designation. "It has taken us a surprisingly long time to get to this point. We now recognize the seas as the indispensable reservoir of water, that commonest, most extraordinary, most abused and most essential of all chemical compounds in our lives. We also appreciate more adequately the sea's life-supporting potential; its wealth in energy, food and raw materials and we seek new methods to enhance and harvest these resources for mankind."

Provost Walter Rosenblith saw the designation as a natural step for the Institute.

"We were uncommon in being a private institution on the list of Land Grant colleges. Today we become the first private Sea Grant College. The designation completes the range of frontiers we face scientifically, technically and socially. It completes our horizon conceptually.

"The designation is logical because M.I.T.'s work on the oceans has a long history, beginning with the Department of Naval Architecture 25 years after our land grant collegeship.

"The Sea Grant College designation is an essential event in the extension and development of M.I.T.'s concerns, and we're very proud of it."

If M.I.T.'s horizon is complete, it is only temporary, one can be sure. After all, it's only logical. . . . M.I.T. as a Space Grant College? — *D.M.*

Bringing Sea Grant to the Customers

M.I.T.'s Sea Grant Program now has an extension service to bring marine-related research results to those who need them. It's the result of a cooperative agreement with the University of Massachusetts Extension Service.

The Extension Sea Grant Advisory Program will sponsor meetings, issue publications, and hold briefing sessions on Sea Grant work at the two institutions and on such related issues as wetlands protection, harbor management, dune stabilization, and boat ownership.

Tuition Up 8.75 Per Cent to $4,350

Effective at the beginning of the Summer Session, tuition at M.I.T. will be at the rate of $4,350 a year. That's an increase of $350 — 8.75 per cent — over this year, and it's the eighth consecutive annual tuition increase.

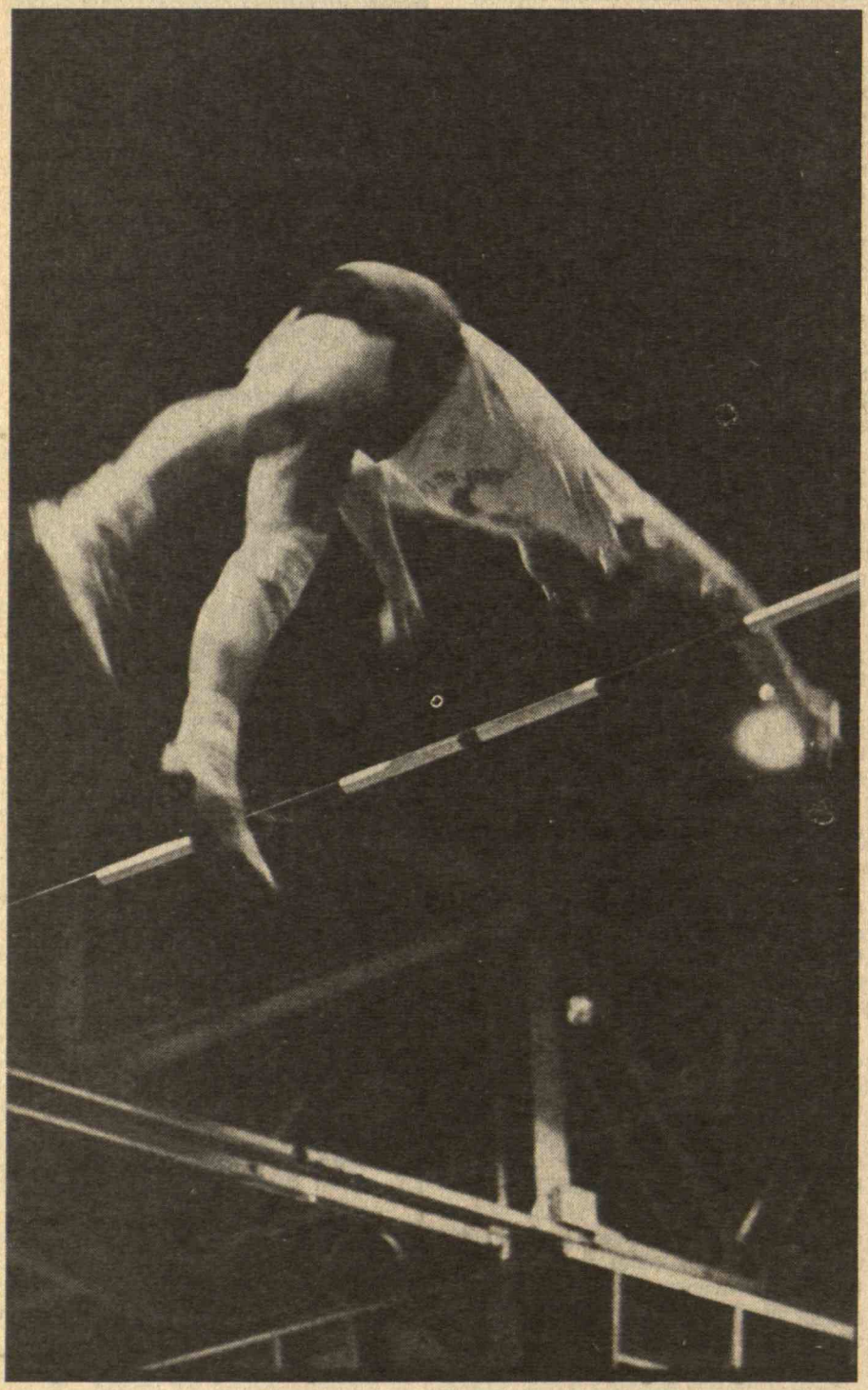
Paul E. Gray, '54, Chancellor of the Institute, says the Institute's flow of income from other sources continues to be inadequate in the face of rising costs; tuition increases are required. But he noted that in real terms, discounting inflation, M.I.T. tuition has been unchanged since 1972.

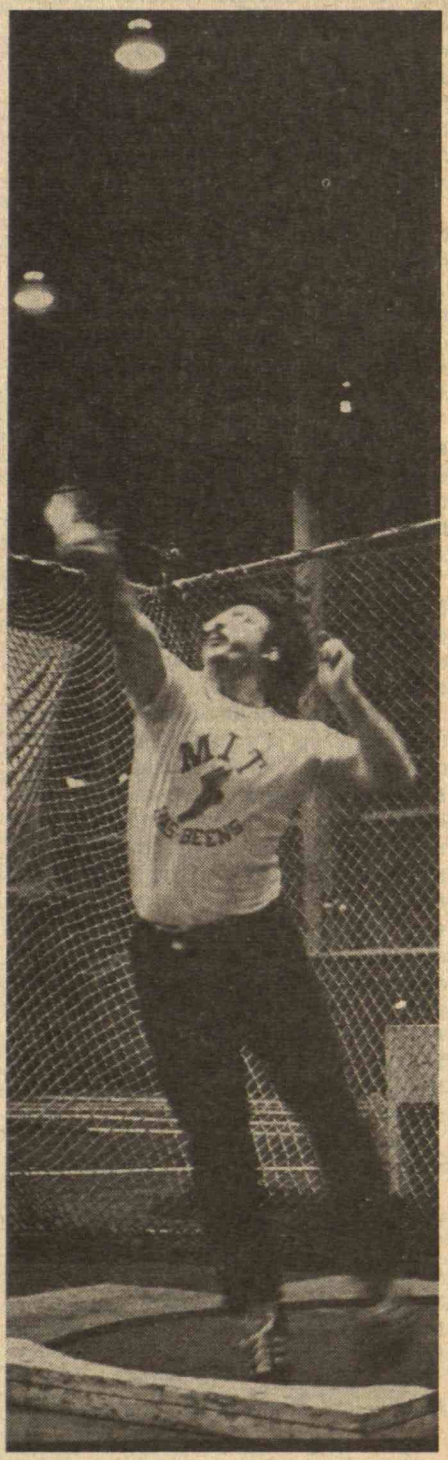
The Institute's academic and general expenses were $93.1 million in 1975-76, and this year they will be about $96 million. A year ago, 1975-76, tuition income contributed $29.3 million toward these expenses; in 1976-77 the tuition contribution will be about $3 million higher.

No one seemed startled by the fact or the amount of the increase for 1977-78. Mitchell Trachtenberg, '78, of *The Tech* wrote that it "is in the same range as expected at the Ivy League colleges, schools with which M.I.T. competes for students." And Peter H. Richardson, '48, Director of Admissions, told Mr. Trachtenberg that — though he is "appalled by what it costs to go to M.I.T., . . . there is nothing in any analysis we have done that suggests that the tuition increase will make any difference to the Admissions Office.

Students responded to the tuition announcement with a brief, almost lighthearted protest at a party ending the Independent Activities Period: "$4,350 — too damn much!" was the chant, and one student censured his colleagues for eating M.I.T.'s refreshments while simultaneously griping about tuition. But the episode was short-lived.

David R. Wilson, '73 (left), and Brian W. Moore, '73, were among alumni who returned to the campus on December 11 to star in the annual alumni-varsity track meet. Though 12 alumni records were bested or tied during the afternoon, the varsity's strength was too much for the "old grads"; the score was 64-49. (Photos: Roger N. Goldstein, '74)





Varsity Track Overhauls the Alumni, 64-49

Fifteen alumni track stars returned to M.I.T. to put fear in the hearts of this year's varsity on December 11. But it was an empty threat as youth won out, 64-49.

The graduates, coached by former Coach Arthur E. Farnham, Jr., included three All-Americans and four current or former M.I.T. record-holders. Jeffrey M. Baerman, '76, flew in from Chicago to pick up victories in the mile (4:25.8) and 1,000-yard run (2:22.8) runs, and former All-American Brian W. Moore, '73, captured the weight throw (53′3″) and shot put (46′8″).

The undergraduate varsity had to compete without Richard K. Okine, '77, the team's leading scorer, and Co-Captain Joseph R. Egan, '77; but the squad's depth more than made up for the talent-laden alumni team. The latter members traveled collectively over 5,000 miles to compete.

Other individual winners among the alumni were William F. Leimkuhler, '73 (50-yard dash — 0:05.6), and David R. Wilson, '73 (pole vault — 14′6″). Second-place rankings went to Gregory L. Hunter, '76 (hurdles), Walter W. Hill, Jr., '73 (mile run), James S. Banks, '76 (50-yard dash), and Mr. Leimkuhler (600-yard run). Capturing third-place rankings for the alumni squad were Gary R. Wilkes, '74 (long jump and 50-yard dash), I. Yaw Akoto, '74 (triple jump), Albert K. Lau, '73 (hurdles), Thomsen J. Hansen, '74 (600-yard run), Mr. Hill (two-mile run), and Mr. Hunter (shot put).

James M. Flink, '64, Associate Professor of Food Engineering, was Assistant Coach for the alumni. Twelve meet or alumni records were broken or tied.

Technology Day Ranges from Outer Space to Ocean Depths

Alumni attending the 1977 M.I.T. Technology Day, June 10, will be treated to lectures and demonstrations on a wide variety of research by young M.I.T. faculty. The lecture program, as always, will be set amidst a two-day program of departmental and class reunions, luncheons and receptions, a memorial service, and a concert by the Boston Pops orchestra with the famed maestro Arthur Fiedler.

The Technology Day program will be moderated by Thomas F. Jones, '40, M.I.T.'s Vice President for Research, and according to its organizers, will feature something to interest every alumnus:

☐ New sources for new products will be discussed by Eric von Hippel, '66. Dr. von Hippel, Assistant Professor in the Sloan School of Management, has discovered that a great many ideas for successful innovations in industry come not from the seller but from the customer looking to buy them.

☐ Deep-sea mining promises to be a highly profitable venture, but according to Associate Professor of Ocean Policy Judith Kildow, it raises a number of technological and political questions.

☐ Man's exploration of the solar system, and its impact on his philosophy will be the subject of a talk by John S. Lewis, Associate Professor of Chemistry and Geochemistry. The explorations begun in this century could mark the beginning of a new view of our place in the universe, he says.

☐ The need to cleanse our industrial emissions has given rise to ingenious new pollution control devices, several of which are under development at M.I.T. James R. Melcher, '62, Professor of Electrical Engineering will demonstrate how electrical forces are being used to clean the air.

☐ While many artists are using the computer to make music, few are using it to help them compose music. Associate Professor of Humanities Barry Vercoe will demonstrate for the Technology Day audience how he and his colleagues use the M.I.T. Experimental Music Studio to help the composer hear immediately the results of his creativity.

Besides the formal program, Technology Day will also feature numerous displays around the Institute of M.I.T.'s research and history. There will also be a special presentation on M.I.T.'s history at the annual awards luncheon, and, according to Technology Day organizers, each participant in the day's activities will receive a souvenir — something they'd never expect!

Information and registration materials can be obtained by calling or writing Joseph Martori, M.I.T. Alumni Association, E19-438, phone (617) 253-4876. — *D.M.*

The Earth, Computers, Topics for Alumni "Summer Adventures"

Alumni participating in the new Alumni Summer Colleges this summer will have a chance to either explore the new revolution in earth sciences in the geological wonderland of the Rocky Mountains or tour the future world of computers with M.I.T. faculty in Cambridge.

The Summer Colleges are designed "to give M.I.T. alumni a chance to learn more about new developments in science and technology, and at the same time to have a pleasant and rewarding vacation experience," according to a newly published brochure on the program.

The week-long programs this year are entitled "The Computer, Your New Man Friday," to be held July 10-16 at M.I.T., and "Planet Earth, the Monumental Sculpture," to be held July 17-23 in Aspen, Colorado.

The programs will feature lectures, demonstrations and slide shows by M.I.T. faculty, as well as numerous field trips and actual hands-on experience with new technological tools. For instance, participants in the Cambridge program will have a chance to work with computer systems used at M.I.T. Participants in the Aspen program will take guided hikes through the Rockies to learn first-hand about mountain-building, erosion, and other geological processes.

Both Summer Colleges will include extensive children's programs. The Cambridge program will feature swimming, tennis, sailing, visits to M.I.T. labs and Boston landmarks, and a boat cruise. The Aspen program will include swimming, tennis, fishing, hiking, a trip to a ghost town, and a chuck wagon dinner in the mountains. Both Summer Colleges will also feature a special pre-college counseling program with tips from M.I.T. staff members on applying to college and obtaining financial aid.

The Cambridge program on computers, headed by Professor Robert M. Fano, '41, will explore how computers will soon enter into everyone's lives as personal assistants.

"Although computers have affected us profoundly, so far we have experienced them only indirectly," said the program brochure. "Our traffic with airline, bank, or other corporate computers has been through their human representatives.

"In the future, however, more and more people will come into direct contact with computers, as hardware costs drop, computer networks proliferate, and 'humanized' programs allow more natural human-computer communication."

The College organizers stress that no previous knowledge of computers is needed to enjoy and participate in the program, which will include demonstrations of computer systems being developed at M.I.T. for medical diagnosis, education, art, and music.

"The basic wealth of humanity comes from the earth," says the prospectus for the Aspen program, to be headed by Professor Stanley Hart of M.I.T.'s Department of Earth and Planetary Sciences. "Our mineral riches, our fuels, and our food supplies depend upon the complex processes of geophysics.

"And some of our most devastating disasters, from earthquakes to floods to volcanic eruptions, arise from physical changes in the earth and its atmosphere. Until recently we knew very little about the forces which shape the planet on which we are so dependent.

"But now major theoretical advances have brought us much closer to understanding the complex phenomena of mountain-building, the formation of continents, the origins of earthquakes and the formation of mineral and fuel deposits.

"The Aspen Alumni Summer College will cover these fascinating new developments and help participants to a better understanding of the shaping of the earth and the oceans. What better place to study earth sciences than in the Rocky Mountains — a veritable geologic wonderland?"

Information on both Alumni Summer College programs may be obtained by writing Nancy Wheatley, Rm. 7-206, M.I.T., Cambridge, Mass. 02139. — *D.M.*

Thirteen Reunions — a Surfeit of Nostalgia

At least 1,500 alumni will be on the M.I.T. campus between June 8 and 12 for class reunions — a week dedicated to nostalgia which will feature more experiences in old Boston than any single alumnus could probably have had.

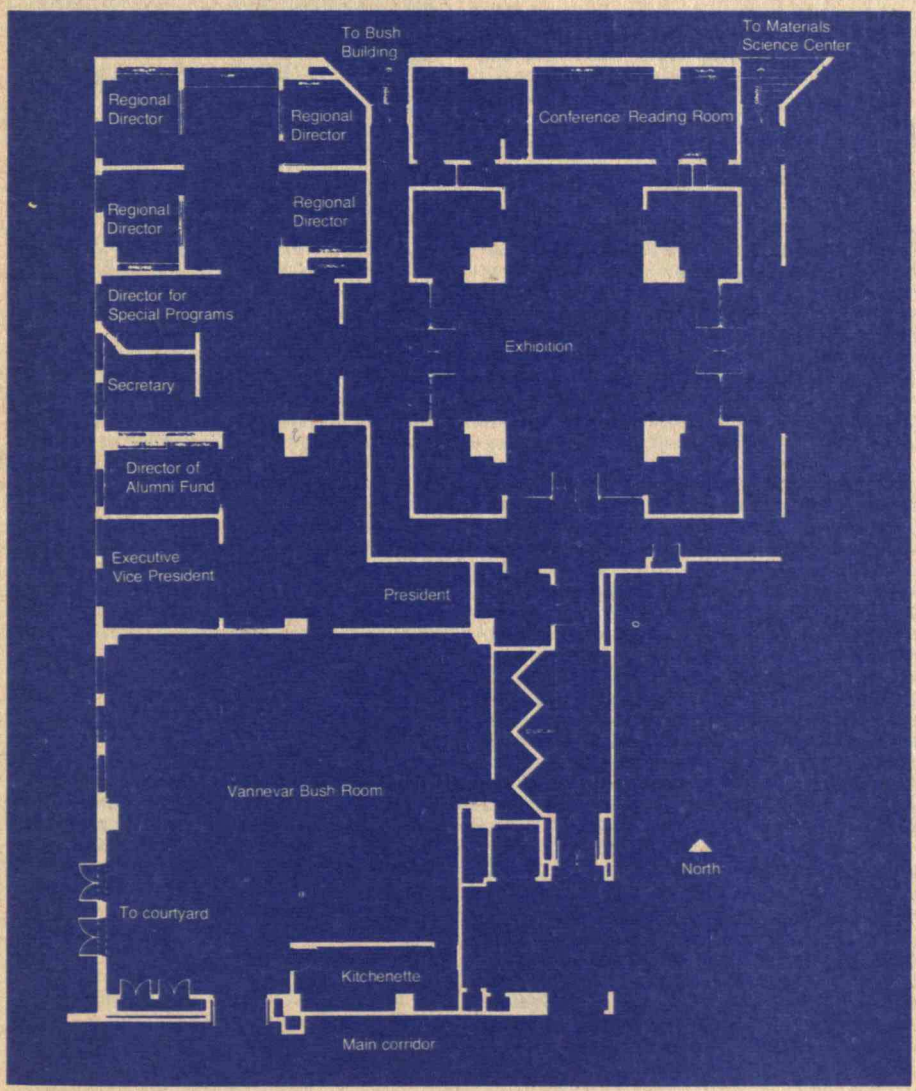
Three classes — 1957, 1947, and 1942 — will enjoy clambakes on George's Island in Boston Harbor. One — 1952 — will have an evening reception in the upper rotunda of the newly restored Quincy Market, in the shadow of Faneuil Hall. The Class of 1937 plans a day-long outing at the Essex Country Club; 1932 will travel to Sandwich for a day at Heritage Plantation and the famous Sandwich Glass Museum. Everyone will visit the M.I.T. Historical Collections, and almost everyone will be entertained by President and Mrs. Jerome B. Wiesner in the President's House.

All but two of the 13 classes scheduling reunion activities will have headquarters on the M.I.T. campus. The 50-year Class of 1927 will gather at the Wianno Club on Cape Cod on Monday, June 6, coming to M.I.T. for Technology Day activities on June 9, and the 60-year Class of 1917 will travel to the Chatham Bars Inn on Cape Cod on June 10.

Other classes planning reunions: 1912, 1922, 1937, 1967, and 1972. For information, write to Joseph J. Martori, Director for Alumni Services, Room E19-438, M.I.T., Cambridge, Mass., 02139.

What will Room 10-250 be like by fall? A model helps Harry P. Portnoy (right), Senior Architect in the M.I.T. Planning Office, explain to Breene M. Kerr, '51, who is Chairman of the committee seeking a $1.3 million Building 10 Fund within the Alumni Fund for the project. The goal will also cover major reconstruction on the first floor of Building 10 to create a new Alumni Center at the heart of the M.I.T. campus (below).

Room 10-250 will have new acoustical treatment, new seats, a new projection booth, and new treatments of exits and entrances. Below it, on the first floor, is to be an exhibition hall surrounded by offices for the President, Vice President, Secretary and Regional Directors of the Alumni Association. The Bush Room will become an integral part of the Alumni Center, managed by the Alumni Association for use by community groups of all kinds; and there will be improved access to the courtyard behind Building 3.



Courses

I
Civil Engineering

Oral Buyukozturk, formerly Adjunct Associate Professor of Engineering at Brown University, is now Associate Professor at M.I.T. His degrees are from the Technical University of Istanbul and Cornell (M.S. 1969, Ph.D. 1970 in structural engineering).

With the Alumni

E. L. Bourodimos, Ph.D. '66, is Professor of Civil and Environmental Engineering at Rutgers University; his research is in the area of hydrodynamics and water resources. In March, 1976, Professor Bourodimos was elected an associate member of the Academy of Athens, the highest academic institution of learning in Greece.

II
Mechanical Engineering

Adam C. Bell, Sc.D. '69, who has been Visiting Associate Professor in the Department since 1975, has joined the faculty as Associate Professor; he formerly taught in engineering and applied sciences at the State University of New York in Buffalo. . . . **Hendrik G. Stassen,** Associate Professor at the Delft University of Technology, the Netherlands, is Visiting Associate Professor; his specialties are in control engineering, man-machine systems, and rehabilitation of the handicapped.

Four young engineers have joined the faculty as Assistant Professors: **Peter W. Huber,** '74, has been Research Assistant and part-time Teaching Assistant at M.I.T. . . . **Alician V. Quinlan,** '68, will be Arthur D. Little Assistant Professor of Environmental Sciences and Engineering; her undergraduate degree is in the life sciences and she holds advanced degrees in physical oceanography (M.S., University of Alaska, 1970) and environmental engineering (Ph.D., M.I.T., 1975). . . . **Derek Rowell,** Director of the Sensory Aids Evaluation and Development Center, adds a faculty appointment; his degrees are from the University of Canterbury, Christ Church, New Zealand. . . . **Nak-Ho-Sung,** Sc.D. '72, has been Research Associate and Lecturer in the Fibers and Polymers Division.

With the Alumni

William H. Heiser, Ph.D. '62, Chief Scientist of the U.S.A.F.'s Arnold Engineering Development Center, will be the Editor-in-Chief of the American Institute of Aeronautics and Astronautics' new publication, the *Journal of Energy* . . . **Charles E. Hepner,** M.S. '50, has begun a new career in patent law since he graduated from Yale Law School in 1968. He is associated with the firm Kenyon and Kenyon, Reilly, Carr and Chapin in New York City and finds his work "challenging and hectic, but lots of fun, too." His family now includes his wife Anne, a son (14), daughter (8), a goat and 18 chickens . . . . **Sidney Whitt,** S.M. '34, will retire from a full-time professorship at the State University of New York in August, but it's no real retirement because he has been appointed an Adjunct Professor for Environmental and Resource Engineering at S.U.N.Y. . . . **Bertram S. Noyes,** S.M. '69, is working at the General Electric plant in Lynn, Mass., on jet engine fuel controls. In 1974 he married Sayre Atkinson and they have a son, Daniel, who is 1 year old.

III
Materials Science

With the Alumni

Cyril S. Smith, Sc.D. '26, Institute Professor Emeritus at M.I.T., was a panelist at discussions on "Technology and Art," "Modular Art," and "Multi-dimensional Geometry" at the Rhode Island School of Design during January. . . . **Robert C. Ruhl,** Ph.D. '67, was promoted recently to Vice President of Engineering of Chase Brass and Copper Co., a subsidiary of Kennecott Copper Corp. He writes, "Our group has achieved a major breakthrough recently in software for machine and process control using minicomputers. The new CONTROL language has wide applicability and offers at least a 5 to 1 cost savings over FORTRAN and other computer languages." . . . **Michael B. Bever,** Sc.D. '42, Professor of Materials Science at M.I.T., is co-editor of the journal, *Conservation and Recycling*. . . . **John J. Burke,** Ph.D. '68, Associate Director for Plans and Programs at the U.S. Army Materials and Mechanics Research Center, Watertown, Mass., is editor of the *U.S. Army ManTech Journal*. Mr. Burke is a member of the American Men of Science, co-editor of 15 technical books, and co-author of the first book on titanium, *Titanium in Industry*.

IV
Architecture

Richard Tremaglio, '68, Associate Professor of Architecture, has been appointed Adjunct Professor in the Department; he'll specialize in teaching architectural design. Professor Tremaglio joined the faculty in 1970; he has been a visiting critic at Yale, Berkeley, Toronto, Arkansas, and the Rhode Island School of Design.

With the Alumni

Rex M. Ball., M.A.R. '58, President of the architectural-engineering-planning firm of HTB, Inc. (formerly Hudgins, Thompson, Ball & As-

Charles A. Zraket, S.M. '53, (right) is sworn in as Chairman of the Massachusetts Advisory Committee on Computers and Data Processing by Governor Michael S. Dukakis; he will advise state officials on the use of the state's $88-million computer and data processing network.

sociates, Inc.), was elected to membership on the National Municipal League's Governing Council at their conference last November; he will also serve on the League's Development Committee which funds the All-America Cities Program . . . . **Sandra Wadsworth,** M.A.R. '74, has joined the staff of Clifford A. Cooper as an apprentice architect.

V
Chemistry

Ernest R. Gilmont

Rolf H. Towe

With the Alumni

Henry A. Hill, Ph.D. '42, President of Riverside Research Laboratories of Haverhill, Mass., assumed office as President of the American Chemical Society on January 1 . . . **Larry Bowen,** Ph.D. '61, runs the North Carolina State University chapter of Sigma Xi . . . **Ernest R. Gilmont,** Ph.D. '56, Technical Director for A. Gross and Co., Millmaster Onyx Group of Newark, N. J., was the third recipient of the annual Distinguished Service Award of the Association of Consulting Chemists and Chemical Engineers which was presented in late January. He was honored for his efforts as an advocate for the social responsibilities of scientists and for his practice of chemistry as a science and as a profession. Dr. Gilmont is also current Chairman of the Board of the American Institute of Chemists and Vice President of the Scientific Manpower Commission as well as a member of numerous professional organizations . . . . **E. S. Rittner,** '39, Director of Applied Sciences for Consat Laboratories, is an Associate Editor of the *Journal of Energy,* a new publication of the American Institute of Aeronautics and Astronautics. . . . **Rolf H. Towe,** S.M. '61, has been appointed Vice President of the Chemicals and Plastics operating unit of Union Carbide Corp.; he will be responsible for cellular and elastomer materials. Mr. Towe, his wife Neely and their two children currently reside in Hong Kong but will return to the United States soon.

VI
Electrical Engineering

Cyril Leung, who studied at Imperial College London, and Stanford (Sc.D. 1976) is Assistant Professor in the Department; his teaching and research are in communications, information, and complexity theories. **Marcus Zahn,** '67, Associate Professor in the Department of Electrical Engineering at the University of Florida, will be Visiting Associate Professor at M.I.T. for one year beginning in the fall.

With the Alumni

Charles A. Zraket, S.M. '53, Senior Vice President of Technical Operations at MITRE Corp., has been named Chairman of the Massachusetts Advisory Committee on Computers and Data Processing by Governor Michael Dukakis. . . . **John G. Truxal,** '47, Dean of the College of Engineering and Applied Sciences at the State University of New York at Stony Brook, was invited to give a lecture at Bucknell University in honor of the inauguration of their new President; his subject was "Technology and Liberal Learning."

John R. Whitford, S.M. '49, has been elected President and Chief Executive Officer of REL Inc., a manufacturer of communications and defense electronic equipment . . . . **Douglas R. Cobb,** S.M. '65, is Vice President and Director of Engineering of the Audichron Co., Atlanta, Ga. . . . **Peter Jessel,** Ph.D. '72, is a research assistant in the Laboratory of Computer Science at M.I.T. . . . **Arthur Fox,** S. M. '72, is a project engineer for Hewlett Packard's Medical Electronics Division . . . **John J. Guarrera,** '43, a professor in the School of Engineering and Computer Science at California State University in Northridge, has been elected Vice President for Professional Activities of the Institute of Electrical and Electronics Engineers.

Edward E. David, Jr., Sc.D. '47, a former White House science advisor, has resigned as executive vice president of Gould, Inc., a Chicago-headquartered manufacturing firm, to establish his own consulting firm. He is also president-elect of the American Association for the Advancement of Science . . . . **Laurence R. Swain, Jr.,** S. M. '60, left his position as Director of Engineering for Adage, Inc. of Boston last October to become Director of Engineering at Market Forge, a division of Beatrice Foods, located in Everett, Mass . . . . **Ronald R. Parker,** Sc.D. '63, group leader of the Alcator fusion experiment in the Francis Bitter National Magnet Laboratory at M.I.T., has received the Distinguished Associate Award of the U. S. Energy Research and Development Administration for his achievements in the field of fusion research. . . . **Peter W. Dietz,** '74, is an electrical engineer at the General Electric Research and Development Center, Schenectady, N. Y.

Gene Brown to Department Head

Gene M. Brown, Professor of Biochemistry in the Department of Biology, will be Head of the Department effective in July; he's been Associate Head since 1972 and for five years before that was Executive Officer.

Professor Brown will succeed Professor Boris Magasanik, who has been Head during a decade of "exceptional growth and achievement." Robert A. Alberty, Dean of the School of Science, says the Department is now recognized as "one of the strongest in the country." Its faculty now includes three Nobel laureates, and during the ten years of Dr. Magasanik's leadership the faculty has grown from 27 to 37 and the number of undergraduates majors has more than doubled.

Professor Brown came to M.I.T. in 1954 from the University of Texas, where he was a postdoctoral fellow; his degrees are from Colorado A. and M. (B.S. in chemistry, 1949) and the University of Wisconsin (M.S. 1950 and Ph.D. 1953 in biochemistry). He is well known among M.I.T. undergraduates for his teaching in the general biochemistry subject taken by students in many departments, and he's been widely recognized for research in enzymology.

Schmitt Award to Hamburger

The 1976 F. O. Schmitt Lectureship Medal and Award of the Neurosciences Research Program were given last fall to Viktor Hamburger, Professor Emeritus in the Department of Zoology at Washington University, St. Louis.

Dr. Hamburger's lecture was "The Developmental History of the Spinal Motor Neuron"; he is noted for work in experimental neurogenesis — the developmental mechanisms by which the nervous system is created.

Toward a True Mathematical Literacy

"The transcendent ideal" of mathematics is to be "a fundamental and universal form of knowledge," says Professor Felix E. Browder, '46, of the Department of Mathematics at the University of Chicago. But that ideal is far from being realized and largely ignored; instead, for most people mathematics represents "a vaguely defined and somewhat monstrous threat looming in the background of present-day life.

"What might have been an increase in human powers and freedom," writes Professor Browder in the *American Mathematical Monthly* (April, 1976), turns out instead to have the opposite impact, "depressing human possibilities rather than raising them."

Mr. Browder defines four kinds of mathematics on the basis of the uses to which it is to be put. Mathematics I is the utilitarian mathematics of which we all use a little every day and some of us — bankers, statisticians, engineers, architects — use a great deal. Mathematics II represents the use of mathematics — as, for instance, by scientists — to describe phenomena in other intellectual disciplines. Mathematics III is the creative mathematics represented by research in such fields as number theory and reasoning.

But Mathematics IV is the universal language, the vision of Leibnitz and Descartes of a "total science of intellectual order, the ultimate and transparent form of all human knowledge and practice," says Professor Browder; and it is this potential for human betterment which is essentially unrealized today.

Why our failure? Because teachers view mathematics only in practical (Mathematics I), technical (Mathematics II), or research (Mathematics III) terms. Their lack of vision represents "a profound defect in our fundamental concept of mathematical and scientific education for nonspecialists." We need to understand, says Professor Browder, that "the overwhelming novelty in human thought for many centuries to come will be the dominant role of mathematical understanding." — *J.M.*

X
Chemical Engineering

John P. Longwell, Sc. D. '43, formerly Senior Scientific Adviser in Corporate and Government Research at Exxon Research and Engineering Co., is now Professor of Chemical Engineering; he's been Visiting Professor in the Department during several recent years. Dr. Longwell is a past president of the Combustion Institute, and his teaching and research are in the fields of combustion and energy conversion.

Preetinder S. Virk, Sc.D. '67, has returned to the Department from the Indian Institute of Technology, Madras, to be Associate Professor; he was a member of the faculty from 1966 through 1972. Dr. Virk will also serve as consultant to the Process Industries Group at Stone and Webster Engineering Corp.

Two appointments of Assistant Professors: **William M. Deen,** whose degrees are from Columbia and Stanford Universities, is associated with the Harvard-M.I.T. Program in Health Sciences and Technology; he was formerly Adjunct Assistant Professor in the Departments of Medicine and of Physiology at the University of California, San Francisco. . . . **Frederick A. Putnam,** who has worked in absorption, adhesion, and abhesion at Dartmouth, Case Western Reserve, and Carnegie-Mellon, is Assistant Professor.

Guy T. McBride, Jr.

With the Alumni

Edward A. Mason, Sc.D. '48, former head of the Department of Nuclear Engineering at M.I.T. and a member of the U. S. Nuclear Regulatory Commission, joined Standard Oil Company (Indiana) as Vice President of Research in January . . . **Richard Wuopio,** S. M. '60, is senior project engineer at Chevron Chemical Co. . . . **Francis R. Russell,** Sc.D. '36, had retired after over 35 years with Exxon Corp. and then taught for three years at a local county vocational technical school (he lives in Sparta, N.J.) and now has retired again. . . . **Guy T. McBride, Jr.,** Sc.D. '48, President of the Colorado School of Mines, Golden, Colo., has been named a Fellow of the American Institute of Chemical Engineers in recognition of his work as an industrial executive and as a researcher in the earth science and mineral fields, and especially for his contributions as a university professor and administrator.

XIII
Ocean Engineering

Commander **Clark Graham,** U.S.N., Ph.D. '69, has been promoted from Associate Professor to Adjunct Professor; his degrees are in mechanical engineering, and his research and teaching are in high-performance marine vehicles and power systems.

Melvin E. Stern, Ph.D. '56, Professor of Oceanography at the University of Rhode Island, is part-time Visiting Professor at M.I.T. this year. Professor Stern's specialty is geophysical fluid dynamics, and he has made important contributions to understanding instabilities in both atmosphere and ocean environments. His M.I.T. teaching is in the field of ocean circulation and stratification in which he first worked as a physicist at Woods Hole Oceanographic Institution from 1957 to 1964.

With the Alumni

W. C. Nolan, S. M. '62, is currently Head of the Department of Applied Science and Engineering at the U. S. Coast Guard Academy where he formerly served as Chief of Shipbuilding and Maintenance and Assistant Chief of the Naval Engineering Division . . . **Randolph W. King,** N.E. '49, has been named Executive Director of the Maritime Transportation Research Board of the National Research Council's Commission on Sociotechnical Systems. He is a retired rear admiral and has held numerous engineering and research managment positions during his 30-year naval career, some of which include: executive director for planning of the Naval Ships Systems Command, head of the engineering department at the U. S. Naval Academy, commander of the Naval Ship Research and Development Center, and deputy commander of research and technology of the Naval Systems Command. Most recently Mr. King was a senior engineering and management consultant with Specialized Systems, Inc., of Mystic, Conn. . . . **John T. Drewry,** S. M. '66, has reported a change in employment. He is now Vice President of Operations of Advanced Marine Enterprises, Inc., located in Crystal City, Va., and also attends George Washington University for a M.B.A. degree. . . . **E. Michael Riordan,** Ph.D. '68, is the co-author of *The Solar Home Book* published by Cheshire Books.

XIV
Economics

Peter A. Diamond, Ph.D. '63, is now Associate Head of the Department; he'll help Professor **E. Cary Brown** with the problems of appointments and curricula that take much of a department head's time. Professor Diamond, who's been a member of the Department since 1966, is an economic theorist whose specialty is public economics; he was a member of the Congressional Research Service's Consultant Panel on Social Security last year, and he's Associate Editor of the *Journal of Public Economics*.

Three new appointments in the Department announced this winter:

☐ **Avinash K. Dixit,** Ph.D. '68, Professor of Economics at the University of Warwick, England, will be Visiting Professor during the Spring Term.

☐ **Thomas J. Rothenberg,** Ph.D. '66, a specialist in econometrics who is Associate Professor of Economics at the University of California, Berkeley, is Visiting Associate Professor at M.I.T. during the current year.

☐ Dr. **Jeffrey E. Harris,** who has combined the study of medicine (M.D., University of Pennsylvania, 1974) and economics (Ph.D., University of Pennsylvania, 1975), has been named Assistant Professor in the Department. He is associated with Massachusetts General Hospital and with the Harvard-M.I.T. Program in Health Sciences and Technology.

How President Jimmy Carter Confronts the Problem of Economic Decisions

President Jimmy Carter's future economic policy cannot be read from today's newspapers — or tomorrow's. No matter how the new President might wish it, the traumas and strengths of this year's economy belong to his predecessor, Gerald R. Ford.

What about the economic package President Carter presented to Congress within the month of his inauguration? "A poor indicator of policies to come," and at best a small factor in the economic state of the nation in 1977, says Lawrence R. Klein, Ph.D. '44, Professor of Economics at the University of Pennsylvania. It simply fulfills President Carter's campaign pledge: if the Ford administration failed to spend all the money Congress authorized in 1975-76, return the surplus — it turned out to be about $10 billion — to the people.

Professor Klein was one of President Carter's chief economic advisers during the Presidential campaign, and he joined two of his Carter campaign colleagues — Professor Carolyn Shaw Bell of Wellesley and Professor Lester D. Thurow of M.I.T. — for an evening of recollections and prognostications at M.I.T. early this year.

During the campaign, President Carter focused on long-term goals for his administration: a balanced budget, price stability, and minimal unemployment by 1980. But he wisely avoided making firm commitments, said Professor Klein: "If you want to be in a certain place in 1980, don't lock yourself into permanent policies too soon. If you commit yourself to a particular change in the tax system and then the revenues aren't there to implement your promise . . . that spells trouble."

Maintaining Flexibility and Diversity

As President Carter begins to develop his longer-term economic program, there's talk of stimuli through increased public works programs, public service employment, reduced employer contributions to government insurance programs, and investment tax credits. The media may call this "something for everyone — the Carter style," but that's wrong, said Professor Klein. It's simply a question of not putting one's eggs all in one basket, of maintaining flexibility and diversification until the short-term effects of the 1977 economic package become evident.

President Carter's partiality toward public works as a stimulus also reflect his desire for flexibility: public works funds can be quickly allocated to distressed geographical areas and distressed segments of the labor force.

Four other stimuli in President Carter's economic plan were predicted by Professor Klein:

☐ Strong emphasis on manpower training, to upgrade unemployed workers and to use upgraded workers for training.

☐ Tax reforms to simplify the tax system and increase its equity.

☐ Welfare reforms, emphasizing greater federal participation.

☐ Increased agricultural production to build up depleted food reserves and thus stabilize food prices.

Planning for Fuller Employment

Manpower was her specialty for the Carter campaign, but after a year and more of study Professor Bell still finds manpower policy a complex, frustrating problem which will call for "a whole range of diversified, innovative programs." Here are three small, unpublicized pieces which she expects will be part of an ultimate Carter program:

☐ Give released prison inmates the equivalent of unemployment benefits; the rate of re-employment will go up, says Professor Bell. And she suspects the same plan could be used for all kinds of job-seekers.

☐ Only one out of 17 re-employed workers finds a job through the state and federal employment services offices; indeed, "the whole process of matching unemployed people to jobs is done very badly in the U.S.," she said. One of the President's goals will be to improve this system.

☐ We now emphasize the restructuring of people to fit jobs; but the other route — restructuring jobs to fit people — may be a better way to reduce unemployment. For example, increasing the number of part-time jobs would "serve a group of people who loom large in the unemployment picture," suggested Professor Bell.

Learning to be an Agnostic

More emphasis on the need for flexibility, from Professor Thurow: no one knows how to forecast the impact of the severe winter of 1976-77 on the economy, and that being the case we can guess that "everybody will blame something on it." So President Carter had better "be agnostic with respect to all economic indicators for a few months," says Professor Thurow. He admits that will be hard advice to follow, if only because the cold weather will have one highly predictable effect: "an enormous short-term increase in inflation generated by increased food prices."

The smiles belong to William F. Pounds (left), Dean of the Sloan School of Management, and Denman K. McNear, '48, President of the Southern Pacific Transportation Co. They were photographed together early this winter to mark the refurbishing of a Sloan Building classroom (E52-143); money for the renovation came from the Southern Pacific Foundation, which Mr. McNear headed before becoming President of the parent company.

The Press in the Election: Candidates Up, Parties Down; the Cost of Turning "Groovy"

Television is changing presidential politics, says Walter D. Burnham, Professor of Political Science; political parties "are decaying as cue-givers" to voters, and "people are looking at the personal image of the candidates." That's because of many people's increasing reliance on television for their news; "newspapers are auxiliaries in the background," Professor Burnham said in an *Editor and Publisher* forum this winter.

Edwin Diamond agrees, but he thinks newspapers, as well as television, are responsible. "Newspaper editors are trying to put out papers that look like television," Mr. Diamond said in the same forum for the newspaper trade journal, "— young, 'groovy,' white-space, picture-oriented — and they're not taken seriously.

"I'd like to suggest that as television and newspapers become less and less serious about more and more things," Mr. Diamond continued (he's a former *Newsweek* editor, now Senior Lecturer in the Department of Political Science), "the public tends to discount what they are a-twitter about."

And when *Editor and Publisher* asked about the influence of the 1976 television debates on the election of Jimmy Carter, Messrs. Burnham and Diamond responded with consistent analyses. The debates helped Mr. Carter "demonstrate himself as a credible alternative to the incumbent," said Professor Burnham. But "they didn't change the way people voted . . . . a reinforcement mechanism, not a conversion mechanism," said Mr. Diamond.

XV
Management

Russell M. Barnes

Raymond J. Epich

With the Alumni

Joseph Rengel, S. E. '60, Executive Vice President of Nuclear Energy Systems at the Westinghouse Electric Corp., has been elected to the Board of Directors of the Atomic Industrial Forum . . . **Newton H. Hoyt, Jr.,** S. M. '37, has been named President of Singer Credit Corp., a wholly-owned subsidiary of The Singer Co. Mr. Hoyt lives in Cos Cob, Conn. . . . **Gerald P. Cahill,** S.M. '58, Executive Vice President and Treasurer of the Torin Corp., manufacturers of air handling equipment, has been elected President by Torin's Board of Directors. Mr. Cahill lives in Simsbury, Conn., with his wife and three children. . . . **Russell M. Barnes,** S.M. '64, an electronics engineer and long-time head of the Aerospace Services Division at Pan American World Airways, has been named Vice President of Contract Services at Pan Am. He and his wife, Margaret, and their two children live in Satellite Beach, Fla. . . . **John D. Rudolph,** S.M. '73, has been appointed plant manufacturing engineer at the Science Products Division of Corning Glass Works in Parkersburg, Va.

John P. Eberhard, S.M. '59, Director of the Research Association of the American Institute of Architects, was a member of the organizing committee for the conference, "The Influence of Limited Resources on Housing Production and Delivery" sponsored by the Engineering Foundation . . . **Raymond J. Epich,** S. M. '54, has been elected Vice President of Management Information Services for Northwest Industries, Inc., Chicago, Ill. . . . **Walter E. Hildick,** '28, Board Chairman of the Curtis & Marble Corp., Worchester, Mass., has been named Chief Executive Officer and Executive Vice President of Central New England College . . . **Leroy E. Day,** S. M. '60, continues as Deputy Director of the Space Shuttle Program, N.A.S.A. headquarters, Washington, D.C. He writes that the flight tests of the first orbiter will begin this spring at Edwards, Calif. . . . **Gordon S. Cochrane,** S. M. '67, became President of Sun Oil Trading Limited in Hamilton, Bermuda, in September, 1976.

XVI
Aeronautics and Astronautics

Rene H. Miller, H. N. Slater Professor of Flight Transportation, was honored by the New York Academy of Sciences when he received the I. B. Laskowitz Award for research in aerospace engineering sciences, support systems and components in December.

With the Alumni

Marc L. Sabin, Sc.D. '73, has been promoted to Major in the U.S. Air Force; he is now attending the Armed Forces Staff College and will attend the Defense Systems Management College in July . . . **W. Cooper Scott III,** S.M. '61, has been named Manager of Civil Meteorological and Environmental Programs for the Aerojet ElectroSystems Company's Washington, D.C., office.

Jack Howell, S.M. '72, a first officer for Eastern Airlines, presented a series of four lectures this winter on aviation and aerodynamics at the Museum of Science in Boston, sponsored by the Airline Pilots Association, International . . . **John C. Ruth,** Sc.D. '67, has been reassigned from Ohio to Eglin Air Force Base in Florida to be Chief of the Data Management Division of the Weapon System Evaluation Program, with responsibilites for evaluating the Air Force's combat capability for tactical air-to-air missile systems. . . . **H. F. Lloyd,** S. M. '46, a captain in the U. S. Navy, has been a college administrator at Flagler College, St. Augustine, Fla., since retirement . . . . **Mack Mauldin,** S. M. '62, has been appointed supervisor of residence services at Drake University, Des Moines, Iowa.

Charles L. Budde, S. M. '70, Captain, and **Roger P. Neeland,** S. M. '70, Major, have earned the U. S. Air Force Commendation Medal for Meritorious Service: Budde at the Air Force Materials Laboratory at Wright-Patterson Air Force Base, Ohio; and Neeland at Korat Royal Thai Air Force Base, Thailand . . . **William A. Van Brunt,** S. M. '69, has been appointed Associate Counsel of Hershey Foods Corp.; he lives in Hershey, Penn., with his wife, Charlet, and their two children. . . . **James P. Reilly,** Sc.D. '67, was spotlighted as Personality of the Month in the *New England Engineer.* Dr. Reilly is Chairman of the Avco Everrett Research Laboratory Aerophysics Committee and Vice President of the Applied Technology Program Office, and a former member of the Plasma Dynamics and Laser Research Committees. He and his wife are elected Town Meeting Members of Lexington, Mass., and active in the Families for Interracial Adoption (now the Open Door Society), and he is an officer in the Lexington Minutemen.

Draper Joins the Alumni Association as Edwards Moves to Admissions

Joseph A. Edwards, '72, who's become well known to alumni in the southeastern states as Regional Director of the M.I.T. Alumni Association, will now wear a new hat and travel nationwide for M.I.T.: he's Director of the Educational Council, and he'll work with alumni throughout the country who help high school students interested in careers in technology and — especially — in M.I.T.

Mr. Edwards' successor as Regional Director is Martha Stark Draper, who's held a variety of administrative posts at the Institute since 1969. Ms. Draper — her father is Charles S. Draper, '26, Emeritus Professor of Aeronautics and Astronautics for whom the Draper Laboratory is named — has most recently been Associate Director of the Undergraduate Research Opportunities Program and Coordinator for M.I.T.'s joint program with the Detroit Institute of Technology. She studied history at the University of the Pacific (B.A. 1964) and Boston University (M.A. 1965).

How a Dutch Architect Teaches American Students to Find Structure in Diversity

After a year at M.I.T., John Habraken, who came from the Netherlands to become Head of the Department of Architecture in September, 1975, is fully satisfied. What struck him when he first visited the Institute was "the rich variety of people and ideas... There was a willingness, even a need, to see many, many aspects in each problem.

"I liked it very much then and I like it very much now," Professor Habraken told Maijaleena Elkins, Editor of the Newsletter of the School of Architecture and Planning, this fall.

"But diversity makes sense only if there is an underlying common ground," said Professor Habraken.

Architecture is in transition — an "identity crisis in the profession," describes it — from the goal of creating exceptional monuments to "the cultivation of everyday environment. In history, architects were concerned about the church, the town hall, and the rich man's house. During the past 50 years they have become concerned about everything else . . . a broadening of the field, a total shift in problems."

For educators and students, this diversity represents a new and challenging problem. "There can be no one rule for an architect," said Professor Habraken. "We do not provide clear-cut models. On the contrary, we encourage students to go in different directions and to raise questions. That's the most important aspect: questions without answers.

"Uncertainty is not a negative thing; it does not make us helpless. It is the only atmosphere in which things can develop and grow. . . . The challenge we have to face is . . . how to learn to deal with complex decisionmaking processes."

But in the end there has to be a common understanding; "accepting diversity makes sense only if there is an underlying common ground." This lesson has been forced on the Dutch by their circumstances — "simply because there is not enough space, hasn't been for centuries."

In the U.S. it's different; we're only beginning to learn that "you can have individual freedom only if you agree to accept certain structure in the society that you build together." Professor Habraken told Ms. Elkins that he "finds it very interesting. The two countries represent the two sides of a coin."

A Women's Advocate in Search of "General Human Liberation"

The academic and personal well-being of women students at M.I.T. are now the special responsibility of Holliday C. ("Holly") Heine, '67, who has returned to the Institute as Assistant Dean for Student Affairs. Dr. Heine's undergraduate and graduate (Ph.D.'73) degrees are in biochemistry, and she joined the Dean's Office from Harvard Medical School, where she had been Research Fellow in Medicine since 1975.

Though her special job is to help women at the Institute, Dr. Heine says that can't be accomplished by aiming all the effort toward only one sex. "The point is a general human liberation," she told David B. Koretz, '78, of *The Tech*. "We want to get a lot of input, to see what ideas come from a wide variety of sources."

J. A. Edwards

M. S. Draper

H. C. Heine

J. Habraken

G. P. Dinneen

F. Press

N. B. Leventhal

F. M. Jarman

J. F. Moore

Carter Turns to M.I.T. for Two Major Appointments in his New Administration

As this issue of *MIT 77* goes to press, the M.I.T. community is anticipating major roles for two of its members in President Jimmy Carter's new administration:

☐ **Gerald P. Dinneen,** Director of Lincoln Laboratory, was nominated by President Carter to be Assistant Secretary of Defense on February 25, and Senate confirmation hearings were scheduled for early in March.

☐ **Frank Press,** Head of the Department of Earth and Planetary Sciences, was widely rumored to be President Carter's choice for Presidential Science Adviser and Head of the Office of Science and Technology: the announcement was apparently being delayed pending security checks, but Dr. Press was known to be spending most of his time in Washington.

Dr. Dinneen came to Lincoln Laboratory after graduate work in mathematics at the University of Wisconsin in 1953; his first assignment was on applications of analog computers for real-time control systems. Later he became Associate Head of the Information Processing Division, then Head of the Communications Division and finally Associate Director (1966) and Director (1970). Dr. Dinneen cited his "highest respect" for Harold Brown, President Carter's choice for Secretary of Defense, "and I'm really glad to join his team," Dr. Dinneen told *The Tech.*

Dr. Press was considered a "long-shot candidate" for the White House Science Adviser, though he is widely known and respected as a scientist and as a member of the National Science Board, the governing body of the National Science Foundation.

President Jerome B. Wiesner told *Science* that Professor Press "has the kind of experience and background that will make an extremely good science adviser . . . . He took a reasonably good department and very quickly turned it into one of the world's best by the sheer power of his quiet leadership," Dr. Wiesner said, referring to Professor Press' appointment to M.I.T. from Caltech in 1965.

Science Adviser to the Legislature

Richard H. Bolt, who was a member of the M.I.T. faculty in physics and electrical engineering for 20 years beginning in 1945, is midway in a unique six-month appointment as Visiting Scientist to the Massachusetts Legislature. His assignment, as Dr. Bolt describes it, is to serve as liaison between public policy-makers and the state's scientific and technical experts.

Dr. Bolt is convinced that many important public problems can't be solved without technical information, and he wants to interest more of the Bay State's many scientists and engineers in understanding and helping with the legislative process.

Dr. Bolt's assignment — it's unique in the U.S., he thinks — is funded by a grant from the National Science Foundation; in it he's associated with the State House Science Resource Network, headed by Chandler H. Stevens, Jr., Ph.D. '67. Dr. Bolt was for many years Director of the interdepartmental Acoustics Research Laboratory at M.I.T.; he was a founder and is now Chairman Emeritus of the Cambridge consulting firm of Bolt, Beranek, and Newman, Inc., and he recently headed an advisory panel to Judge John Sirica investigating the Watergate tapes.

The Selection Committee Reports: Leventhal is Alumni President

Norman B. Leventhal, '38, General Partner in the Beacon Companies, Boston, will be President of the M.I.T. Alumni Association in 1977-78.

Mr. Leventhal and seven other alumni who will become officers of the Association on July 1, 1977, were chosen late this winter by the 1977 Selection Committee. Ballots for members of the 1978 Selection Committee will be mailed to all alumni in a national election during April.

Mr. Leventhal, who graduated from M.I.T. in civil engineering, has been a leader in community and civic activities in Boston and in Class and Alumni Fund activities for M.I.T. His firm is engaged in development and building construction, and he is a former President of the Associated General Contractors of Massachusetts, Inc., and a former Director of the Associated General Contractors of America.

Other alumni chosen by the Selection Committee to lead the Alumni Association beginning next July include:

☐ **Franklin M. Jarman,** '53, Chairman of Genesco, Inc., Nashville, to be vice President (two years). Mr. Jarman, who studied in the Course in General Engineering at M.I.T., was Chief Executive Officer of Genesco from 1973 to 1977. He has been a member of the M.I.T. Corporation's Development Committee and of its Visiting Committee to the Sloan School of Management.

☐ **Joe F. Moore,**'52, President of Bonner and Moore Associates, Inc., Houston, to be Vice President (two years). A graduate in chemical engineering, Mr. Moore has been a Director of the Association since 1975 and has been prominent in the M.I.T. Club of south Texas.

☐ **Ward J. Haas,** '43, Vice President-Research and Development of Chesebrough-Pond's, Inc., Trumbull, Conn., to be Director (District 3) for two years. Following graduate study at M.I.T. (Ph.D. '49) in biochemistry, biophysics, and management, Dr. Haas held research positions with Pfizer, Inc., the University of Missouri, Warner-Lambert Co., and S. C. Johnson and Son, Inc., before taking his present post in 1975. He's been a Director of the Alumni Center of New York and was Chairman of the 1976 Alumni Officers Conference.

☐ **Robert W. Wright, Jr.,** '50, Partner in Keck, Cushman, Mahin, and Cate, lawyers, Chicago, to be Director (District 6) for two years. Mr. Wright attended Harvard Law School after graduating from M.I.T. in management, and he has practiced law with his present firm since 1954. He's also been active in the M.I.T. Club of Chicago and in local and civic groups in Kenilworth and New Trier, Ill.

☐ **Russell L. Law, Jr.,** '48, Special Agent for the Northwestern Mutual Life Insurance Co. in Miami, to be Director (District 7) for two years. Mr. Law first represented Northwestern Mutual Life in Wichita from 1955 to 1957, and he has since then been located in Miami where he's been prominent in the M.I.T. Club of South Florida.

☐ **Edward Hanley,** '48, President of Ed-

W. J. Haas

R. W. Wright, Jr.

R. L. Law, Jr.

E. Hanley

H. H. Strauss

ward Hanley and Co., Denver, to be Director (District 8) for two years. Mr. Hanley's business — designer and contractor specializing in residential kitchens — was founded in 1950, and he has been instrumental in organizing the American Institute of Kitchen Dealers. He's been active in the M.I.T. Club of Colorado and for more than 20 years a member of the M.I.T. Educational Council.

□ **Harold H. Strauss,** '38, consulting engineer of Los Angeles, to be Director (District 9) for two years. Mr. Strauss has over 40 years of professional experience in engineering and management; he is a Fellow of the Institute for the Advancement of Engineering, past President of the California Society of Professional Engineers, and former Director of the National Society of Professional Engineers; and he's been a member of the M.I.T. Educational Council since 1960.

Three Alumni for the Corporation

Yaichi Ayukawa, '52, Chairman of CPC Japan, Ltd., Tokyo; **Denman K. McNear,** '48, President of the Southern Pacific Transportation Co., San Francisco; and **F. Richard Meyer,** '42, business consultant of Chicago, have been nominated for membership on the M.I.T. Corporation by the 1977 Selection Committee of the Alumni Association.

When confirmed by the Corporation, they will join M.I.T.'s governing body for five-year terms beginning on July 1, 1977.

Dr. Ayukawa holds three degrees in food technology from M.I.T., and he was Research Director for Best Foods and Vice President for Technical and Business Development before taking his present post with CPC Japan, Ltd., in 1975. He is a member of the Corporation Development Committee and of the Visiting Committee to the Department of Nutrition and Food Science.

Mr. McNear joined the Southern Pacific upon completing his Master's degree in Stanford's Graduate School of Business in 1950; he studied civil engineering at M.I.T. Mr. McNear has been a major factor in alumni activities in the San Francisco area, working for the Educational Council, the Alumni Fund, and the M.I.T. Club of San Francisco; and he's also been a member of the Corporation Development Committee and of its visiting Committee to the Department of Civil Engineering.

As a consultant, Mr. Meyer specializes in the field of mergers and acquisitions; his M.I.T. degree is in the field of management. At various times during the past 25 years he has filled almost every assignment for the Alumni Association in the Chicago area, and he was a member of the Association's Board of Directors for six years beginning in 1970.

Individuals Noteworthy

Kudos: Honors, Awards, Citations

To **Bruce C. Murray,** '53, Director, Jet Propulsion Laboratory, the Space Science Award from the American Institute of Aeronautics and Astronautics . . . to **Walter O. Lowrie,** '48, Vice President for Technical Operations of the Martin Marietta Corp.'s Denver Division, the Space Systems Award from the A.I.A.A. . . . to Major **Roger P. Neeland,** S.M. '70, the U.S. Air Force Commendation Medal for meritorious service at Korat Royal Thai A.F.B., Thailand . . . To **Charles L. Budde,** S.M. '70, the U.S. Air Force Commendation Medal for meritorious service at the Air Force Materials Laboratory at Wright-Patterson A.F.B., Ohio.

To **Ernest R. Gilmont,** Ph.D. '56, Technical Director, A. Gross and Co., Millmaster Onyx Group, a Kewanee Industry, Newark, N.J., the annual Distinguished Service Award of the Association of Consulting Chemists and Chemical Engineers . . . **Robert A. McClatchey,** '60, Research Physicist for the U.S. Air Force Geophysics Laboratory at L. G. Hanscom Air Force Base, honored as the 22nd annual Guenter Loeser Memorial Lecturer . . . A paper written by Lt. Cmdr. **Jon Bryan,** N.C. '73, and two colleagues, selected as the best paper of 1976 by the Materials Division of the American Society of Mechanical Engineers.

Councelors: Officers, Directors, Advisors

John J. Guarrera, '43, of the School of Engineering and Computer Science, California State University in Northridge, Calif., to Vice

Y. Ayukawa

D. K. McNear

F. R. Meyer

President for Professional Activities of the Institute of Electrical and Electronics Engineers . . . **Donald W. Male,** S.M. '58, to the Board of Trustees of the Unitarian Universalist Association . . . Alan H. Cohen, '61, to Vice Chief of Staff of Los Alamitos General Hospital in California . . . **Arthur M. Poskanzer,** Ph.D. '57, senior chemist at the Lawrence Berkeley Lab, to Chairman of the Division of Nuclear Chemistry and Technology of the American Chemical Society. **Herbert L. Carpenter, Jr.,** '44, Director of Research for Greif Bros. Corp., to Vice President.

Hans-Lukas Teuber, 1917-1977: "The Most Successful Synthesis of What We Have Learned About Mind and Brain"

Professor Hans-Lukas Teuber, the founding Head of the Department of Psychology who was a leading authority on the relationship between brain and behavior, disappeared on January 4 while swimming in waters off Virgin Gorda in the British Virgin Islands; he was 60. Dr. Teuber was a strong and enthusiastic swimmer, and it is presumed that he suffered a heart attack or was trapped in strong currents; despite an extensive search, his body was not recovered.

President Jerome B. Wiesner's statement used words echoed throughout the Institute community by those who knew Dr. Teuber: ". . . a most tragic and personal loss . . . an inspiring and charismatic teacher. . . . We loved him greatly and we shall miss him sorely."

Professor Walter A. Rosenblith, Provost, spoke of Dr. Teuber's "scientific acumen, exquisite taste, and encyclopedic wisdom. . . . His name has come to stand for what is up to this day the most successful synthesis of what we have learned about mind and brain," said Professor Rosenblith. "His was a cohesive vision in the midst of fragmentation."

At the time of his death, Professor Teuber was vacationing with Mrs. Teuber in the Virgin Islands while preparing the two Killian Lectures he was to deliver at M.I.T. on January 12 and 19; instead of the second lecture, Kresge Auditorium was filled on that date for a service of remembrance at which no less than 16 of Dr. Teuber's colleagues and friends spoke in tribute to his memory.

Dr. Teuber came to M.I.T. in 1961 from the faculty of the Bellevue Medical Center in New York City to head the Psychology Section of the Department of Economics; three years later, in 1964, the Section achieved departmental status and since then has become a major center for teaching and research in brain science, experimental and developmental psychology, and language learning. Dr. Teuber's own research involved pioneering studies of the behavioral effects of brain injuries which became a tool for correlating brain and behavior.

Meanwhile — despite many professional responsibilities and the wide acclaim for his advanced research — Dr. Teuber continued to teach the Department's introductory course in psychology for freshmen and sophomores, making it the most popular undergraduate elective at the Institute — an average of more than 500 students. President Wiesner recalls that his lectures "were perfect models of organization, clarity, charm, and enlightenment."

Professor Teuber was born in Berlin, to parents who were the founders of the first field station for observing the behavior of captive chimpanzees. He was educated at the French College in Berlin, the University of Basel in Switzerland, and Harvard (Ph.D. 1947). During World War II Navy service, even before completing his Harvard degree, Dr. Teuber began his intensive studies of the effects of brain wounds in military casualties, and he continued this work at the Bellevue Medical Center before coming to M.I.T.

Dr. Teuber held many honorary degrees and lectureships and had been an officer of the principal professional societies and committees in his field; last July he was selected by his colleagues to give the major scientific address at the International Congress of Psychology in Paris.

Frank S. MacGregor, 1887-1976

Frank S. MacGregor, '07, whose name was given to MacGregor House as a result of his major gifts for its construction, died at his home in Tryon, N. C., on December 31. He was 89.

Mr. MacGregor had retired to North Carolina after a career with E. I. duPont de Nemours and Co., Inc., where he had advanced to General Manager of the Electrochemicals Department. He studied physics at M.I.T.

Thomas Chambers, 1900-1977

Thomas (Harry) Chambers, who had been a porter in various M.I.T. dormitories from 1924 until his retirement in 1965, died in Boston on January 9; he was 77.

Mr. Chambers was the first President of the Quarter Century Club, an association of M.I.T. employees with 25 years of service to the Institute, and he was active in the Montserrat Progressive Society.

John W. Barriger, III, 1899-1976

John W. Barriger, III, '21, a life-long railroader whose career included the presidencies of four railroads — the Monon, the Pittsburgh and Lake Erie, the Missouri-

Kansas-Texas, and the Boston and Maine — died at his home in St. Louis following a brief illness on December 9; he was 77.

At the time of his death, Mr. Barriger was associated with the Rock Island Lines as a consultant and "Senior Traveling Freight Agent," a title he devised and cherished; he had been Vice President of the Rock Island in the 1950s. In addition to his industrial service, Mr. Barriger was in the Office of Defense Transportation during World War II, the Reconstruction Finance Corp. in the depression years of the 1930s, and the Federal Railroad Administration in 1976.

Mr. Barriger — he studied management with the Class of 1921 — was a frequent visitor at his *alma mater*, often arriving by rail and inviting classmates and members of the Institute to early-morning breakfasts aboard the private cars on which he traveled.

Dino Olivetti, 1912-1976

Dino Olivetti, '40, a director of the Italian office machine company that bears the family name, died in Milan, Italy, on December 24; he was 64. Mr. Olivetti studied in the Course in General Engineering, and after completing his degree at M.I.T. he was Olivetti Corp.'s Director General for a number of years beginning in 1946. Later he returned to the U.S. to join an Olivetti Corp. subsidiary in New Canaan, Conn.

Mr. Olivetti was a member of the Corporation Development Committee.

Leicester F. Hamilton, 1893-1976: A Community Leader for 40 Years

Leicester F. Hamilton, '14, a member of the M.I.T. faculty in the Department of Chemistry for 43 years beginning in 1915, died in Nashua, N.H., on December 22. He was 83.

Professor Hamilton contributed to the Institute community in countless and varied ways. He was in charge of undergraduate chemistry teaching from 1935 to 1942; he was Acting Head of the Chemistry Department from 1942 to 1945 and its Executive Officer from then until his retirement in 1958; and he was the author, with Professor Stephen G. Simpson, '16, of two books familiar to many generations of students: *Calculations in Quantitative Chemical Analysis* and *Analytical Chemistry*.

Meanwhile, Professor Hamilton maintained active interest in and influence on student life; he was Chairman for 25 years of the Dormitory Board, a faculty group organized to support the Institute's Houses and dormitories. In recognition of his interest in intercollegiate crew, an M.I.T. rowing shell was named in Professor Hamilton's honor in 1967.

During Professor Hamilton's years of active teaching, he was known to almost the entire Institute faculty as a mentor and leader; he was Secretary of the Faculty from 1953 to 1958, and he and his wife — the late Mary Alma Nichols Hamilton, who died in 1974 — were active in many faculty community and social affairs. He was a former Grand Master and member for nearly 50 years of the Richard C. Maclaurin Lodge (the "Tech" lodge) of A. F. & A. M.

Professor Hamilton entered M.I.T. with the Class of 1914 from the Medford, Mass., public schools. He was a member of Alpha Chi Sigma, honorary chemical society, and was Secretary of the Northeastern Section of the American Chemical Society from 1920 to 1922.

Steven L. Horn, 1957-1976

Steven L. Horn, '79, failed to see an oncoming car when he turned to cross Harvard Bridge while jogging on December 1; he was seriously injured and died on Christmas night in Mt. Auburn Hospital.

Mr. Horn, a resident of Burton House — his parents were from Camp Hill, Penn. — was a sophomore in chemical engineering. He was a Navy R.O.T.C. scholarship student and a member of the heavyweight crew.

Deceased

Benjamin D. Solomon, 03; January 16, 1977; 1878 Commonwealth Ave., Auburndale, Mass.

Frank S. MacGregor, '07; December 31, 1976; Box 1384, Tryon, N.C.

Hobert W. French, '08; December 14, 1976; 180 Elsinore St., Concord, Mass.

Laurence C. Shaw, '09; December 6, 1976; Box 244, Cotuit, Mass.

Mrs. Ernest L. Patch, '10; July 3, 1975; 721 Alameda St., Vallejo, Calif.

Ludwig Rosenstein, '10; December 13, 1976; 2010 Lyon St., San Francisco, Calif.

Oswald W. Stewart, '11; December 27, 1976; Elm St., R.F.D. 2, Kingston, Mass.

Frank A. Wood, '11; December 30, 1976; c/o Goodwins, Box 340, Exeter, N.H.

John L. Barry, '12; January 11, 1977; 61 Highland Ave., Cohasset, Mass.

Franklin N. Breed, '12; December, 1976; Box 433, Wilton, Conn.

Chester L. Dows, '12; December 28, 1976; 107 Cambridge Ave., Garden City, N.Y.

Oliver W. Holmes, '12; January 14, 1977; 8149 Flourtown Ave., Wyndmoor, Philadelphia, Penn.

Robert J. Tullar, '13; January 16, 1977; 80 W. Baltimore Ave., Wildman Apt. 216B, Lansdowne, Penn.

Leicester F. Hamilton, '14; December, 1976; 15 Swart Terr., Nashua, N.H.

Alfred P. Kitchen, '14; November 5, 1976; 65 Elizabeth Ave., New Rochelle, N.Y.

Roland W. Baldrey, '15; November 1, 1976; 28 Maple St., Arlington, Mass.

Kenneth S. Johnson, '15; November 24, 1976; 1580 Wamponoag Trail, The Meadows, Apt. 112, Barrington, R.I.

G. Vincent Maconi, '15; January 12, 1977; 63 Brookside Dr., New Haven, Conn.

Francis E. Murphy, '15; March 20, 1976; 65 Angelo Ln., St. Augustine, Fla.

Edward H. Barry, '16; December 31, 1976; 46 Old Orchard Rd., Sherborn, Mass.

Harold F. Dodge, '16; December 10, 1976; 780 Pine Ct., Naples, Fla.

Hamilton Wood, '17; December 10, 1976; 4 Bennett St., Manchester, N.H.

John W. Gustaveson, '18; October, 1976; 10440 Wornall Rd., Kansas City, Mo.

James C. Irwin, Jr., '18; July 29, 1976; 707 E. 47th St., Kansas City, Mo.

Albert C. Walker, '18; January 3, 1977; 77 Oakview Terr., Short Hills, N.J.

Christopher W. Duffy, '20; June 26, 1976; 4215 Jenifer St., N.W., Chevy Chase, Md.

William S. Johnson, '20; January 5, 1977; 10895 Crestmont Ave., Philadelphia, Penn.

Garvin Bawden, '21; December 21, 1976; 3400 Gulf Shore Blvd., N., Naples, Fla.

Walter L. Gorden, '22; September 10, 1976; 5 Turner Rd., Normal, Ill.

Russell W. Lowry, '22; October 12, 1976; 294 Washington St., Canton, Mass.

Roscoe E. Sherbrooke, '22; December, 1976; 311 Jerusalem Rd., Cohasset, Mass.

Irving Whitehouse, '22; December 27, 1975; 4409 Renwood Rd., Cleveland, Ohio

Joseph K. Preston, '23; May 7, 1976; 24 Bruver Ave., Wilbraham, Mass.

Thomas P. Coogan, '24; December 3, 1976; 10190 Collins Ave., Bal Harbor, Fla.

T. Thorton Oxnard, '24; November 29, 1976; 2124 Stradella Rd., Los Angeles, Calif.

Lloyd Westbrook, '24; November 8, 1976; 2 Foss Terr., Marblehead, Mass.

Dow H. Drukker, '25; November 18, 1976; 255 Nia Bellaria, Palm Beach, Fla.

Edwin T. Erickson, '25; April 5, 1976; 304 3rd St., Pebble Beach, Waretown, N.J.

Albert M. Prentiss, '25; December 30, 1976; 1037 S. 26th Rd., Arlington, Va.

Paul S. Bauer, '26; January 26, 1977; 4816 Tilden St., N.W., Washington, D.C.

Charles Kandall, '26; September, 1974; 1893 S. Ocean Dr., Hallandale, Fla.

Raymond Mancha, '26; December 20, 1976; 1340 Grove Terr., Winter Park, Fla.

Benjamin P. Richardson, Jr., '26; November, 1976; 4 Fairgreen Ln., Old Greenwich, Conn.

John W. Spence, '26; December 6, 1976; 11 Hole-in-One Dr., South Yarmouth, Mass.

John E. Walker, '26; December 7, 1976; 604 11th St., Brooklyn, N.Y.

Louis F. Eaton, '27; December 12, 1976; Box 132, Snug Harbor Sta., Duxbury, Mass.

Frank E. Rhinehart, '27; January 12, 1977; 2188 Chatfield Dr., Cleveland, Ohio

Francis A. Stubbings, '27; December 24, 1976; 7306 Sheryl Hill Dr., Tarpon Springs, Fla.

Henry Moggio, '28; September, 1976; 2640 Washington St., Allentown, Penn.

Desmond S. Shipley, '28; October 24, 1976; 73 Davis Rd., Port Washington, N.Y.

Norman V. Ballou, '29; January, 1977; Blueberry Hill, Box 271, Dublin, N.H.

Everett C. L. Kroehler, '30; December 31, 1976; Box 54, Naperville, Ill.

William C. McLendon, '30; December 1, 1976; 2128 Fosgate Dr., Winter Park, Fla.

Lewis Eaton, '31; December 27, 1976; 251 Dedham Ave., Needham, Mass.

John P. Elting, '31; December 23, 1976; 4632 Carmel Vista, Charlotte, N.C.

Robert McKenzie, '31; October 27, 1976; 1433 Linden Ave., Glendale, Calif.

Richard W. Ruble, '33; November 19, 1976; 1330 University Dr., #49, Menlo Park, Calif.

Ira L. Grishaver, '35; December 3, 1976; 18 Alton Ct., Brookline, Mass.

Edward S. Prohaska, '35; December 13, 1976; 10 Abbey St., Randolph, Mass.

John J. Petrossi, '36; November 24, 1976; 105 Powers Bldg., Rochester, N.Y.

Theodore R. Timbie, '38; January 8, 1977; Box 165; Hamilton, Mass.

Carl G. Lenk, '39; November 3, 1976; 1270 Birmingham Rd., West Chester, Penn.

Vallentine D. DeOlloqui, '40; December 31, 1976; Garden Heights, Lewisburg, W.Va.

Norman Duffett, '40; December 1, 1976; 5900 Overlook Dr., Erie, Penn.

J. Latimer Jones, '40; September 11, 1976; 1155 Via Tranquilla, Santa Barbara, Calif.

Dino Olivetti, '40; December, 1976

Muller P. Moody, '41; November 28, 1976; 3112 Emerson St., Tampa, Fla.

Louis A. Arnold, '42; December, 1976; 23 Raymond St., Nashua, N.H.

Raymond Wiggins, '50; November 5, 1976; 816 El Miradar Dr., Fullerton, Calif.

Bruce B. Clark, '54; May 17, 1975; 6104 Lone Oak Dr., Bethesda, Md.

James A. Stricklin, '64; August, 1976; Rt. 3, Box 253, Bryan, Tex.

Steven L. Horn, '79; December 25, 1976; 332 Lamp Post Ln., Camp Hill, Penn.

Yes, provide a broad, liberal arts, humanistic education.

No, teach people practical things, so as to guarantee them jobs.

Yes, focus on research and education for the elite.

No, train dental technicians, hotel managers, accountants, but also provide professional education for lawyers, doctors, and engineers.

Yes, stop lowering academic standards, but be sure and enroll more minorities and the poor as a way of creating a more egalitarian society.

And also, while you're at it, provide compensatory education for those victimized by inadequate public schooling, provide opportunities for part-time students, especially for women caught in the homemaker's trap, provide continuing education as job enrichment for workers and executives, and, by the way, become the vehicle through which income redistribution can be achieved.

Obviously, we do not possess the resources to achieve all of these aims. We couldn't, even if we wanted to. By providing a complete menu for every taste we would inevitably and quickly alienate one or another public who would feel disaffected or threatened by one or another of our academic programs and would, actively or passively, turn off its support.

All of our institutions, both public *and* private, confront similar conflict between internal and external environments. In Cincinnati, Procter and Gamble and Federated Department Stores, two of our nation's most successful and well-managed enterprises, must now consider (indeed, are on occasion forced by law to consider) *both* external and internal conflicts, whether nitrates or price-labeling.

The root problem contains profound and grave consequences. It isn't only a matter of a loss of *consensus* over basic values; it is a *polarization* of these values. The university problem is basically a reflection of society's problems, a fact so obvious that we tend to forget it. Education and society are indivisible and cannot be detached from each other. Similarly, Business, with a large "B," is the concentrated epitome of our culture — and is inseparable from it. Coolidge was right that America's business *is* business, and Engine Charlie Wilson was not far wrong with his memorable "what's good for General Motors" remark: business thrives or sickens along with our nation's destiny. All of our institutional fates are correlated with our nation's.

What seems to have happened is this: the environmental encroachments and turbulence, the steady beat of litigation, the fragmentation of constituencies along with their new found eloquence and power, multiple advocacy, win-lose adversarial conflicts between internal and external forces — all of this — has led to a situation where our leaders are "keeping their heads below the grass," as L. B. J. once put it, or paralyzed, or resembling nothing so much as acrobatic clowns. Whatever metaphor one prefers, to grow and stay healthy an institution must strike a proper balance between openness to the environment and protection from too much permeability. Achieving the proper trading relationship without being colonialized is the delicate balance leaders must achieve.

Having to look both ways — in and out, back and forth — was the special gift of Janus, and is required for all leaders today. The "Janus Phenomenon" is a relatively new example of organizational turbulence and leadership optics. Today's leader is surrounded by constituent groups, from inside and outside, as well as by numerous individuals who at any moment, discovering some supposed mutual interest, may suddenly coalesce into some new constituency. In either case, people need slight stimulus to become vocal, organized advocates and activists.

The Cat's Cradle

We know what overstimulation by external forces does to an individual; a total reliance on external cues, stimuli, rewards, and punishments leads to an inability to control one's own destiny. People in this state tend to avoid any behavior for which there is no external cue. Without signals, they vegetate. With contrary signals, they either become catatonic — literally too paralyzed to choose, let alone *act* on a choice, for fear of risk — or, conversely, they lunge at anything and everything, finally contorting themselves into enervated pretzels.

When we apply this analysis to organizations and their leadership, we can observe the same effects. While these coercive political and legal regulations are more pronounced in the public sector than in the private sector, in the latter area the market mechanism has heretofore been the linking pin between the firm and environment, the source of feedback regarding rewards and punishments, and the reflection of the success or failure of decisions. Whether the organization is private or public, whether the controls are legitimate or not, there is only one natural conclusion: an excess of (even well-intended) controls will lead inexorably to lobotomized institutions.

What neither lawmakers nor politicians seem to realize is that law and regulation deal primarily with sins of

commission. Sins of omission are more difficult to deal with, partly, as Kenneth Boulding points out, because it is just damned hard in practice to distinguish between honest mistakes and deliberate evil. Which is another way of saying that legitimate risk-taking can land you in jail. On the other hand, by "playing it safe," by living up to the inverted proverb, "Don't just do something, sit there," an institution, a leader, a person can avoid error, and if continued long enough, they can *almost* avoid living.

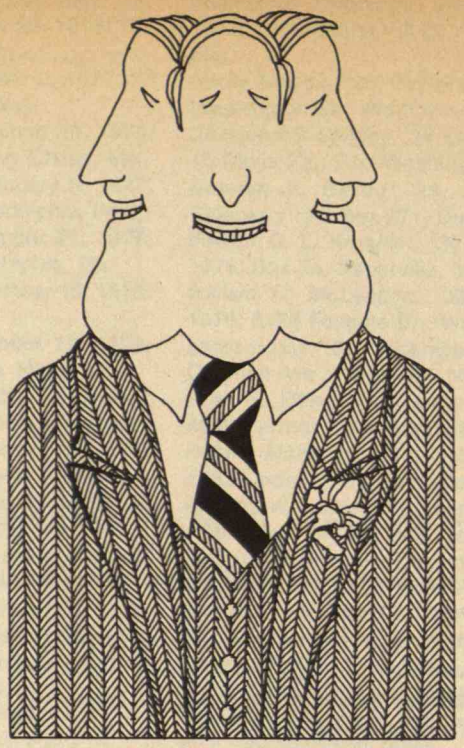
As the legal and political systems become increasingly concerned with sins of commission — a fact exemplified in the dramatic switch from *caveat emptor* to *caveat vendor*, in the deluge of consumer protection legislation, in malpractice suits, in the environmental protection movement, in the court decisions awarding damages to purchasers of faulty products — we can get to a point where no producer, no organization will do anything at all, like the California surgeons who quit operating on any but emergency patients. Why should they? The costs of uncertainty and honest mistakes are now unbearable and far too costly.

At my own and many other universities, for example, we are now in the process of rewriting our catalogues so carefully that it will be virtually impossible for any student (read: consumer) to claim that we haven't fulfilled our end of the bargain. At the same time, because we have to be so careful, we can never express our hopes, our dreams, and our bold ideas of what a university experience could provide for the prospective student. I suspect that in ten years or so, college catalogues, rarely a publication which faculty, students, or administrators are wild about in any case, will devolve into statements that resemble nothing more than the finely printed cautions and disclaimers on the back of airline tickets — just the opposite of what education is all about: an adventurous and exciting odyssey of the mind.

All this — all of the litigation, legislation, and *caveat vendor* — not only diminish the potency of our institutions, but lead to something more pernicious and possibly irrecoverable. We seek comfort in the delusion that all of our troubles, our failures, our losses, our insecurities, our "hangups," our missed opportunities, our incompetence can be located "somewhere else," can be blamed on "someone else," can be settled in the seamless, suffocating, and invisible "system." How convenient, dear Brutus.

Just think: at a certain point, following our current practices and national mood, any sense of individual responsibility will rapidly erode. And along with that, the volume of low-level "belly-aching" and vacuous preaching about "the system" will grow more strident. The result: those leaders who are around either will be too weak or will shy away from the inevitable risks involved in doing anything good, bad, or indifferent.

I am *not* arguing the case against regulations and controls. I am painfully conscious that some of them are necessary if we are to realize our nation's values (e.g., equality of opportunity for all); without them, I fear, our basic heritage would have long ago been indelibly corrupted. (And it is not hard to understand why campaign finances have come under control recently. How do we deal with Gulf's $12 million bribes, including one to L.B.J. in 1962 when he was Vice President?) I am also aware that many of our institutions have, through inactive, corrupt, and inhumane actions, brought on themselves regulations which today they claim are unnecessary.



All the same, when it comes to protecting people from their exploiters we have an extra responsibility to be so vigilant, so careful that we don't end up in a situation where *everyone* is enmeshed by a cat's cradle of regulations erratically tangled together with the filaments of "good intentions."

As Justice Brandeis put it many years ago:

Experience should teach us to be most on guard to protect liberty when the governments' purposes are beneficient. Men born to freedom are naturally alert to repel invasion of their liberty by evil-minded rulers. The greatest dangers to liberty lurk in insidious encroachments by men of zeal, well-meaning, but without understanding.

Variations on a Theme

Memorandum to the People of Ohio's 13th Congressional District:

Summary: Being the Congressman is rigorous servitude, ceaseless enslavement to a peculiar mix of everyone else's needs, demands and whims, plus one's own sense of duty, ambition or vanity. It is that from which Mrs. Mosher and I now declare our personal independence, to seek our freedom, as of January 3, 1977.

It is a Congressman's inescapable lot, his or her enslavement, to be never alone, never free from incessant buffeting by people, events, problems, decisions . . . It is a grueling experience, often frustrating, discouraging, sometimes very disillusioning . . . House debates, caucuses, briefings, working breakfasts, working lunches, receptions, dinners, homework study, and even midnight collect calls from drunks . . . you name it!

I am for opting out. I shall not be a candidate for reelection in 1976.

Charles A. Mosher,
Representative
13th Congressional District
State of Ohio
December 19, 1975

The basic problem is that leaders are facing a set of conditions that seemed to take shape suddenly, like an unscheduled express train looming out of the night. Whoever would have forecast the post-Depression development in the public sector of those areas of welfare, social service, health, and education? Who, save for a Lord Keynes, could have predicted the scale and range of the multi-national corporations? Prophetically he wrote:

Progress lies in the growth and the recognition of semi-autonomous bodies within the states. Large business corporations when they have reached a certain age and size, approximate the status of public corporations rather than that of the individualistic private enterprise.

The Keynesian prophecy is upon us. When David Rockefeller goes to London, he is greeted as if he were a chief of state (and some of his empires *are* bigger than many states). But in addition to the growth of semi-autonomous, often global, corporations which rival governments, we also have public-sector institutions which Keynes could scarcely have imagined. The largest employment sector of our society, and the one growing at the fastest rate, is local and state government. Higher education, which less than twenty years ago was 50 per cent private-50 per cent public, is now about 85 per cent public and is expected to be 90 per cent public by 1980. And, where a century ago 90 per cent of all Americans were self-employed, today 90 per cent work in what can be called bureaucracies, members of some kind of corporate family. They might be called "juristic" persons who work within the sovereignty of a legal entity called a corporation or agency. Juristic persons, not masters of their own actions, cannot place the same faith in themselves that self-employed persons did.

These are the problems of leadership today. We have the important emergence of a Roosevelt-Keynes revolution, the new politics of multiple advocacy, new dependencies, new constituencies, new regulatory controls, new values. And how do our endangered species, the leaders cope with these new complications and entanglements? For the most part, they do not; that is, they are neither coping nor leading. One reason, I fear, is that many of us misconceive what leadership is about. Leading does not mean managing; the difference between the two is crucial. I know many institutions that are very well *managed* and very poorly *led.* They may excel in the ability to handle the daily routine, and yet they may never ask whether the routine should be done at all. To lead, the dictionary informs us, is to go in advance of, to show the way, to influence or induce, to guide in direction, course, action, opinion. To manage means to bring about, to accomplish, to have charge of or responsibility for, to conduct. The difference may be summarized as activities of vision and judgment versus activities of efficiency.

In his decision-making, the leader today is a multi-directional broker who must deal with four estates — his own management team, constituencies within his organization, forces outside his organization, and the media. While his decisions and actions affect the people of these four estates, their decisions and actions, too, affect him. The fact is that the concept of "movers and shakers" — a leadership elite that determines the major decisions — is an outdated notion. Leaders are as much the "shook" as the shakers. Whether the four estates force too great a quantity of problems on the leader or whether the leader takes on too much in an attempt to prove himself, the result is what I call "Bennis' First Law of Pseudodynamics," which is that routine work will always drive out the innovational.

When the well-known author, John Hersey, was permitted to sit for a week in the Oval Office and its antechambers, recording all he saw and heard, he counted (in five working days) more than 4,000 visitors — Indian tribal chiefs, bishops and rabbis, woolgrowers and cattlemen, labor leaders and businessmen, students, blacks — flowing through the President's office in an unending stream. Just to handle the millions of pieces of mail pouring in and out of the White House took some 250 employees. The daily "news summary" occupied six full-time staffers. To collect and screen the names of possible candidates for the 4,000 positions the President controls, there was a staff of 30. The speech-writing team, which turned out 746,000 words during Ford's first 10 months in office, numbered 13, and Ron Nessen's news staff included eight deputies plus 38 other assistants apparently needed to handle the 1,500 news correspondents covering the White House.

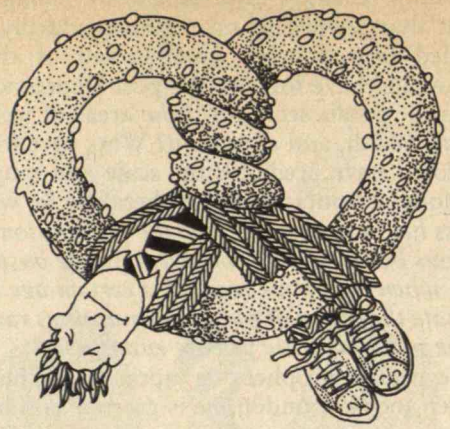
During Lincoln's presidency there was a total of 50 on the White House staff — and that included telegraph operators and secretaries. Roosevelt inherited three secretaries from Hoover; now there are over 3,000. During the Eisenhower and Kennedy years, the staff of the Office of the President increased 13 per cent under each. L. B. J. increased his another 13 per cent, and Nixon increased his by 25 per cent in his first term. Unhappily, the White House overload can be duplicated over the entire corporate and public bureaucratic landscapes. Little wonder there are burnt-out cases or that Congressman Mosher should declare his independence from "rigorous servitude, ceaseless enslavement."

Leading Through Limits

We are now experiencing a transition period that may aptly be called an "era of limits." After the Club of Rome warned us of *The Limits of Growth,* the Arab petroleum boycott, soaring fuel costs, and the continuing energy crisis have confirmed the brutal fact that our national goals have outrun our present means. Some political and institutional leaders exploit this mood by turning the public's disenchantment with growth into a political asset. They want to follow the popular mood, rather than lead it.

The National Observer calls California's young Governor Edmund G. Brown "the hottest politician in America," and quotes him thus: "Growth in California has slowed down . . . the feeling is strongly antigrowth. Once people seemed to think there were no limits to the growth of California. Now Californians are moving to Oregon and Colorado . . . There are limits to everything — limits to this planet, limits to government mechanisms, limits to any philosophy or idea. And that's a concept we have to get used to. Someone called it the Europeanization of America. That's part right. You take an empty piece of land and you fill it up with houses and soon the land is more scarce and the air is more polluted and things are more complicated. That's where we are today. . . ." *The National Observer* says his rhetoric works: "Over 90 per cent of the people in California applaud his performance." (November 29, 1975, pp. 1, 16.)

Compared with the grandiose rhetoric of a quarter-century about the apostolic conviction that size and scale plus technological "know-how" could solve all society's basic problems, the management of decline, as presented



by Governor Brown, sounds at least respectably sane, and especially so when compared with a pronunciamento by one of the leaders of the European Economic Community, Dr. Sicco Mansholt: "More, further, quicker, richer are the watchwords of present day society. We must adapt to this for there is no alternative." *That* kind of rhetoric, especially when at brutal odds with present reality, denies the very nature of the human condition.

Thus, growing in popularity, and becoming more sophisticated in its approach, is a new movement. I call it "cameo leadership," which aspires to carve things well, but smaller. It preaches a "homecoming," a less complicated time, a communal life, a radical decentralization of organizational life, a return to Walden before the Pond was polluted, before the Coke stand made its appearance, before *Walden* itself was required reading ... when things were compassable.

A chief spokesman for this counter-technology movement is E. F. Schumacher, a former top economist and planner for England's National Coal Board. In his book, *Small is Beautiful,* he writes:

— We are poor, not demi-gods.

— We have plenty to be sorrowful about, and are not emerging into a golden age.

— We need a gentle approach, a non-violent spirit, and small is beautiful. . . .

Governor Brown of California is an avid disciple of Dr. Schumacher's "Buddhist economics." Small *is* beautiful. Sometimes. Perhaps it is beautiful more often than big is beautiful. When big gets ugly, we see human waste, depersonalization, alienation, possibly disruption. When small gets ugly, which never crosses Schumacher's mind, it leads to a decentralization bordering on anarchy; also to poverty, famine, and disease.

Small is beautiful. The era of limits is upon us. Who can argue? Nevertheless, these are slogans as empty as they are both appealing and timely. Because they are appealing we fail to see that they represent no specific programs for change. In fact, rather than opening up the possibilities for solutions, they close them with brevity and an exclamation mark. Basically, they reflect the symptoms now afflicting us by setting rhetorical opposites against each other. Small is beautiful, so big must be ugly. A grain of sand may be more beautiful than a pane of glass. But must we trade the glass for the sand (as well as the life expectancy of those protected by glass for that of a Bedouin out admiring that ultimate decentralization, the desert)?

The real point is not one of beauty. The real point is whether leaders can face up to and cope with our present crises, worries, and imperatives. The real problem is how we can lead institutions in a world of over three billion people, millions of whom will starve while other millions can't find work; and for many who do find work it's either boring or underpaid. Many whose work is exciting and provides meaning live with quiet desperation in armed fortresses in fear of "the others." The real question is: How do we provide the needed jobs, and, after that, how do we learn to lead so that people can work more cooperatively, more sensibly, more humanely with one another? How can we lead in such a way that the requisite interdependence — so crucial for human survival and economic resilience — can be realized in a humane and gentle spirit?

Coda

Where have all the leaders gone? They're consulting, pleading, trotting, temporizing, putting out fires, either avoiding — or, more often — taking too much heat, and spending too much energy in doing both. They are peering at a landscape of "bottom lines," ostentatiously taking the bus to work (with four bodyguards, rather than the one chauffeur they might need if they drove) to demonstrate their commitment to energy conservation. They are money changers lost in a narrow orbit. They resign. They burn out. They decide not to run or serve. They read Buddhist economics, listen to prophets of decentralization and then proceed to create new bureaucracies to stamp out old ones. (Nixon's "Anti-Big Government" one was bigger than Johnson's.) They are organizational Houdinis, surrounded by sharks or shackled in a water cage and manage to escape, miraculously, while the public marvels at the feat and then longs for something more than "disappearing acts." They are motivating people through fear, or by cautiously following the "trends," or by posing as Reality through adopting a "Let's Face It" cynicism. They are all characters in a dreamless society. Groping in the darkness, learning how to "retrench," as if that were an art like playing the violin. And they are all scared.

And who can blame them? Sweaty palms are understandable, even natural. That is the final irony. Precisely at the time when the trust and credibility of our leaders is at an all-time low and when survivors in leadership feel most inhibited in exercising the potentiality of power, we most need individuals who can lead. We need people who can shape the future, not just barely manage to get through the day.

There is no simple solution. But there are some things we must recognize:

— Leaders must develop the vision and strength to call the shots. There are risks in taking the initiative. The greater risk is to wait for orders. We need leaders at every level who can lead, not just manage.

— This means that institutions (and followers) have to recognize that they *need* leadership, that their need is for vision, energy, and drive, rather than for blandness and safety.

— This means that the leader must be a "conceptualist" (not just someone to tinker with the "nuts and bolts"). A conceptualist is more than an "idea man." He must have an entrepreneurial vision, a sense of perspective, the time and the inclination to think about the forces and raise the fundamental questions that will affect the destiny of both the institution and the society within which it is embedded.

— This means that he must have a sense of continuity and significance in order, to paraphrase the words of Shelley, to see the present in the past and the future in the present. He must, in the compelling moments of the present, be able to clarify problems — elevate them into understandable choices for the constituents — rather than exploit them; to define issues, not aggravate them.

In this respect, leaders are essentially educators. Our great political leaders, such as Jefferson, Lincoln, and Wilson tried to educate the people about problems by studying the messy existential groaning of the people and transforming murky problems into understandable issues. A leader who responds to a drought by attacking the lack of rainfall is not likely to inspire a great deal of confidence. What we see today is sometimes worse: leaving the problem as a problem (e.g., "the economy" or "the energy crisis") or allowing the problem to get out of control until it sours and becomes a "crisis." What is essential, instead, are leaders who will get at the underlying issues and present a clear alternative. Dr. Martin Luther King, Jr. provided this perspective for black people. We sorely need the same leadership for the whole nation.

— A leader must get at the truth and learn how to filter the unwieldy flow of information into coherent patterns. He must prevent the distortion of that information by over-eager aides who will tailor it to what they consider to be his prejudices or vanities. The biggest problem of a leader — any leader — is getting the truth. Pierre du Pont said well in a long-ago note to his brother Irenée, "One cannot expect to know what will happen, one can only consider himself fortunate if he can know what *has* happened." The politics of bureaucracy tend to interfere with rather than facilitate truth gathering.

That's mainly true because the huge size of our organizations and the enormous overload burdening every leader make it impossible for him to verify all his own information, analyze all of his own problems, or always decide who should or should not have his ear or time. Since he must rely for much of this upon his key assistants and officers, he would not feel comfortable in so close and vital a relationship with men (women, unfortunately, would not even be considered!) who were not at least of kindred minds and of compatible personalities.

Of course, this is perfectly human, and up to a point understandable. But the consequences can be devastating for it means that the leader is likely to see only that highly selective information, or those carefully screened people that his key assistants decide he should see. And he may discover too late that he acted on information that was inadequate or inaccurate, or that he has been shielded from "troublesome" visitors who wanted to tell him what he should have known, or that he had been protected from some problem that should have been his primary concern.

Given the character of today's institutions with their multiple dependencies and advocacies, picking a team of congenial and compatible associates may be deadly, a replay of Watergate. The most striking thing and most obvious impression I remember from the early Watergate hearings is how much all the Nixon aides looked alike. I had trouble telling Dean from Magruder, Porter from Sloan, Strachan from Haldeman. In appearance, they are almost mirror images of the younger Nixon of the 1940s, as if they were that spiritual or ghostly double called doppelganger. It is easy enough to cry shame on Watergate without perceiving its interconnections with our own lives and organizations and, in lesser degree, our conduct.

For in too many institutions a very few people are filtering the facts, implicitly skewing reality, and selecting information that provides an inaccurate picture on which decisions may be based. Such skewing can affect history: Barbara Tuchman in her recent book on China tells how, in the 1940s, Mao Tse Tung wanted very much to visit Roosevelt, but Roosevelt cancelled the proposed meeting on the basis of incredibly biased information from Ambassador Pat Hurley. It was nearly thirty years later that another President sought out the meeting with Mao, which earlier conceivably could have averted many subsequent disasters.

So the leader cannot rely exclusively on his palace

guards for information. Hard as it is to do, he must have multiple information sources and must remain accessible, despite the fact that accessibility in modern times seems one of the most under-rated political virtues. The Romans, who were the greatest politicians of antiquity, and probably also the busiest men, valued that quality highly in their leaders. Cicero, in praising Pompey, commented on his ready availability, not only to his subordinates, but to the ordinary soldiers in his command.

A later Roman historian recounted this even more telling anecdote about the Emperor Hadrian. The emperor, who at that time ruled almost the entire civilized world, was riding into Rome in his chariot when an old woman blocked his path. The woman asked him to hear a grievance. Hadrian brushed her aside, saying he was too busy. "Then you're too busy to be emperor," she called after him. Whereupon he halted his chariot and heard her out.

A pebble dropped in Watergate has its ripples throughout our complex organizational society, and by the same token it is the excesses, the concealments, the arrogance and half-truths of a thousand faceless doppelgangers, in innumerable large organizations, that make a Watergate, an Attica, a Selma possible.

— The leader must be a social architect who studies and shapes what is called the "culture of work" — those intangibles that are so hard to discern but are so terribly important in governing the way people act, the values and norms that are subtlely transmitted to individuals and groups and that tend to create binding and bonding. In whatever goals and values the leader pursues he must proceed toward their implementation by designing a social architecture which encourages understanding, participation, and ownership of the goals. He must, of course, learn about and be influenced by those who will be affected by the decisions which contain the day-to-day realization of the goals. At the very least, he must be forever conscious that the culture can facilitate or subvert "the best laid plans. . ."

The culture of an organization dictates the mechanisms by which conflict can be resolved, and how costly, humane, fair, and reasonable the outcomes will be. It can influence whether or not there is a "zero-sum" mentality that insists upon an absolute winner or an absolute loser or whether there is a climate of hope. There can be no progress without hope, and there can be no hope if our organizations view conflict as a football game, a win-lose (or possibly tie) situation. While zero-sum situations are extremely rare, most leaders (and followers) tend to respond to most conflicts as if there has to be only one winner and only one loser. In reality, organizations and nations are involved in a much different kind of contest, resembling not so much football as it does the remarkable Swedish game, Vasa Run, in which many take part, some reach the finish line earlier than others and are rewarded for it, but all get there in the end.

Lots of things go into producing a culture: the particular technology of the institution, its peculiar history and geography, the characteristics of the people, and its social architecture. The leader must understand these things; he must have the capacities of an amateur social anthropologist so that he can understand the culture within which he works and which he himself can have some part in creating and maintaining.

— The task of the leader is to lead. And to lead others he must first of all know himself. His ultimate test is the wise use of power. As Sophocles says in *Antigone*: "It is hard to learn the mind of any mortal, or the heart, till he be tried in chief authority. Power shows the man."

So he must learn, most of all, to listen to himself. He must integrate his ideals with his actions and, even when a crackling discrepancy exists, learn how to tolerate this ambiguity between the desirable and the necessary, but not so much tolerance that the margins between them become undiscernible. When that happens, the leader is unwittingly substituting an authentic ideal for an evasion of convenience. Soon he'll forget about the goal — and even feel "comfortable" with an illusion of progress. He must learn how to listen to understand, not to evaluate. He must learn to play, to live with ambiguity and inconsistency. And, most of all, the test of any leader is whether he can ride and direct the process of change and, by so doing, build new strengths in the process.

Warren G. Bennis began watching leaders as a student (Ph.D. 1955) and teacher (1953-56, 1959-67) of psychology in M.I.T.'s Sloan School of Management. Then he turned to his present vocation — the practice of leadership in academic institutions — at the State University of New York at Buffalo (Provost 1967-68, Vice President 1968-71) and the University of Cincinnati, of which he has been President since 1971.

Bruce Hannon
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How a society determined to save energy could increase economic stability, employment, and equity.

Energy, Labor, and the Conserver Society

The decisions we make in America today will determine how we use energy in the future. We can continue to accelerate our per capita energy consumption and optimistically rely on emerging technologies, controlled energy prices, or increasingly clever statesmanship to postpone resource shortages. Or we can open the options for a conserver society and adopt the somewhat pessimistic but perhaps more realistic view that there is a limit to the availability of low-cost energy.

The second strategy would be a new one for the U.S., and it is important to consider the technological, social and economic problems that would arise in such an emerging conserver society. Such a society would have to forecast scarcity and plan for shortages of energy. Such a society would learn to juggle supplies of labor and capital — flexible, renewable resources — to fill the gaps left by shortages of nonrenewable resources.

Members of a conserver society would be wise to choose energy, particularly usable solar energy, as the most valuable commodity. Labor can be maintained without nonrenewable energy resources, but capital in any significant quantities requires nonrenewable energy. So capital would be chosen as the next most scarce production input. Recycling of non-energy materials would therefore become a matter of prime importance. Labor would be considered the least scarce input. Consumption would be minimized to avoid the need for an expanding population.

The Relationship of Energy, Wages, and Employment

The three basic inputs to production — capital, labor and energy — are determined in the U.S. system by assigned prices, by free market forces, by regulation (including assigned prices and subsidies), and by taxes. The ratio of any two input prices represents the ratio of the respective productivities (at the margin) of these inputs. Those inputs with relatively high marginal productivities are used more carefully. Those with the lowest marginal productivities are used in a relatively profligate way.

As an example, examine the price ratio trends for the three basic inputs for the U.S. economy during the years 1926 to 1975 (*page 50*). Note specifically the steady rise in the ratio of the industrial worker's wage to the industrial electricity price from 1935 to 1970. In this period, electricity was being substituted for labor in industry. If other social conditions had been constant, this process would have resulted in a considerable amount of unemployment. But during this period, total employment and total energy use rose proportionately. We were rescued by increasing total economic activity. As energy substitution took jobs away, the increased overall demand for goods and services created employment at a compensating rate. New entries into the labor force were also absorbed by economic growth. The result was a roughly constant unemployment rate despite technologic unemployment and a growing population. The shortening of the work week also helped thwart some of the potential unemployment, both by a sharing of the workload and by providing more time for consumption.

During the gradual shift to reduce total labor costs, machines and energy were introduced as substitutes for labor. The workers remaining after each successive substitution became more organized to capture a wage which competed with the rising cost of goods and services. The fact that the high-wage production worker is actually unskilled is to the advantage of the producer who forecasts rapidly rising wages. The producer can relocate his facilities to an area of lower average wages, and easily hire new people because of the short training periods required. On the other hand, organization cannot be refused easily by any new worker since it is clear that any other worker can achieve a relatively higher wage through organization.

But economic growth was not necessary to insure steady employment in a culturally and technologically changing and growing population. Under conditions of zero economic growth, the U.S. could have accomplished full employment in the 1935-to-1970 period by raising the price of energy relative to wages. Note that in the chart on page 50, the wage/electricity price ratio leveled out and dropped sharply in the 1970-to-1975 period. During the last two years of this period total energy use dropped, as did economic activity. But total employment *rose*; and real compensation per man-hour, for the first time in 25 years, dropped (current wages rose). This unique drop in real wages apparently allowed employment to rise (although not fast enough to hold unemployment constant) while energy and economic activity declined. The drop in the wage/electricity price curve between 1970 and 1975 implies the substitution of labor for energy during that period. If low unemployment were to be maintained during such a drastic reduction in energy use and economic activity, real hourly compensation would have had to drop even more sharply. Reduced energy use ultimately means less material wealth. Therefore, the principal problem of the conserver society becomes one of providing and maintaining an equitable distribution of reduced energy and material flows.

Since about 1950, labor and capital have tended not to be substituted for one another. Until about 1971, electricity was substituted for capital. One example of this has been the centralization of production facilities. Highly centralized production required greater system energy use — greater final product transportation energy commitments for transportation of the final product, for example. Centralized production utilizes capital and labor efficiently at the expense of increased use of relatively cheap energy. This is clearly demonstrated in the electric utility industry. The average size of U.S. power plants has grown larger with time. The plants are about 25 per cent efficient — that is, they waste about three-fourths of their input energy. If capital were cheap relative to energy costs, electric plants would be smaller, and they would be located close to demands for their low temperature heat.

Since 1973, rising energy prices relative to capital prices should have reduced the trend toward centralization.

The Constraints of Energy

In general, the conserver society would find increased use of labor and capital coupled with the decreased use of energy. The conservers would also turn to two important physical rules concerning the efficiency of energy use. First, thermodynamics (second law) recognizes that the identical quantities of energy may possess different abilities to do mechanical work; that is, they may contain energy of different qualities. A body at a high temperature contains energy at higher quality than another body at a lower temperature containing the same total energy, for example.

The second physical rule of great importance to the conserver society is the concept of net energy, particularly when applied to the transmission of low quality energy. It is not economic, in terms of energy spent, to transmit low-quality energy (such as warm water) for long distances. However, high-quality energy (electricity) can be transmitted with relatively high efficiency. The frictional power losses are inversely related to the temperature and to the voltage.

These two physical rules will constrain the planners of the conserver society to match energy quality and quantity exchanges in their production processes. The exhaust energy (quality and quantity) of a particular process would be matched with the input energy for an adjacent process. This principle, which can be thought of as "cascading" energy through the production process, is the ultimate source of higher efficiency. The last stages of cascading involve the use of large quantities of relatively low quality energy, so the transmission distances are severely limited. For example, space heating requires large amounts of relatively low quality energy. Thus residential and commercial structures would locate near the production processes. The size of the whole grouping would be limited due to the physical inability to efficiently transmit low-quality energy. Thus we may conclude that raising the price of energy relative to labor and capital changes the scale economies of capital and labor, and in the conserver society both would be used more intensively than at present. With high-priced, intensively-used energy, physical proximity (land use) becomes a very important aspect of production. Such rules would produce cities which would be more independent, more diverse, and smaller than the average today. These communities would have an additional virtue in an energy-conserving economy: they would not require large, energy-intensive urban transportation systems.

Moving With All Deliberate Haste

But the conserver society would begin with small changes to the present society in such a way as to reduce *total* energy use. This does not mean simply reducing use at one point in the system only to find a compensating increase somewhere else. The conservers must also understand in detail the labor impacts of their energy-conserving steps.

In the conserver society, the total energy and employment content of a passenger-mile of automobile or rail transport could be compared with their relative dollar costs, for example. Changes from one transport mode to a more energy-efficient one would produce a net change in total energy and employment use and, in many cases, an excess of income. This "extra" income would be spent on other things which in turn demand energy and employment. These additions should be combined with the initial energy and employment changes to produce an equilibrium set of demand changes.

Therefore, the main question which faces the conservers as they plan for their first few steps is: What specific changes in the present economy will reduce energy demand and increase employment, under conditions of income equilibrium?

Seeking answers to this question, we have examined hundreds of specific consumer decisions and evaluated their dollar, energy, and employment demands. By comparing high-energy-using decisions with lower-energy-using alternatives, and incorporating the re-spending ef-

This table contains the net total employment change per quadrillion B.t.u. of net total energy change. The numbers in this table are calculated as follows: for each unit of service, for example a passenger-mile, the differences of the direct and indirect energy and employment demands of an activity and its alternative are calculated; to these differences are added the direct and indirect energy and employment caused by the expenditure of any dollar savings on average personal consumption; a ratio of the net employment to the net energy change is then formed and normalized to one quad of energy. (References: Bezdek and Hannon, 1975; Folk, 1972; Hannon, 1972; Hannon, 1975; Hannon, Harrington, Howell and Kirkpatrick, 1976.)

fects, we can determine the net energy and employment change caused by the substitution. All of the changes proposed would reduce energy use before the re-spending effects were included. If, for each substitution, the net change in employment demand is divided by the net change in energy demand, one has an indication of the job potential per unit of energy saved (or new) for each conservation project.

Our aid in this process is the energy and employment impact model used by the Energy Research Group at the University of Illinois Center for Advanced Computation. Basically, this is an input-output model containing inter-industry dollar transactions, direct physical energy flows, and the numbers of jobs (by occupation) required in each industry. The total (direct and indirect) energy and employment demand from the entire economy can be determined per unit of output of a particular technology.

My calculations in this paper are based on the average energy and employment intensities (direct plus indirect energy demand) rather than the marginal intensities. However, the more mature industries operate at a long-run minimum-cost condition where average and marginal responses to changes in production are equal. This is also true for industries containing a relatively large number of firms. The effects on energy and labor demand of the capital investment required to make the shifts are neglected. In the long run, they are small when the activity itself rather than the construction program is considered. Also, since I am holding total Gross National Product constant for each of the activity shifts, I believe that net capital expenditure changes are small. The general effect of energy conservation on employment is one of our present research areas.

Relating Energy and Jobs

The table on the right lists some activities in order of decreasing numbers of new jobs created per energy units saved. The options presented cover nearly an entire order-of-magnitude range in the number of new jobs created per quad (quadrillion B.t.u.) of energy saved. Given that the present U.S. energy use is about 80 quad and reducible unemployment is at most 4 million persons, full employment could be reached (leaving about 3 per cent frictional unemployment) with energy use reduced by approximately 5 to 10 per cent through implementation of the first category of changes in the table.

The viability of this point of view is essentially supported by the aggregate behavior of the U.S. economy in 1974. New jobs were gained at the rate of 930,000 per

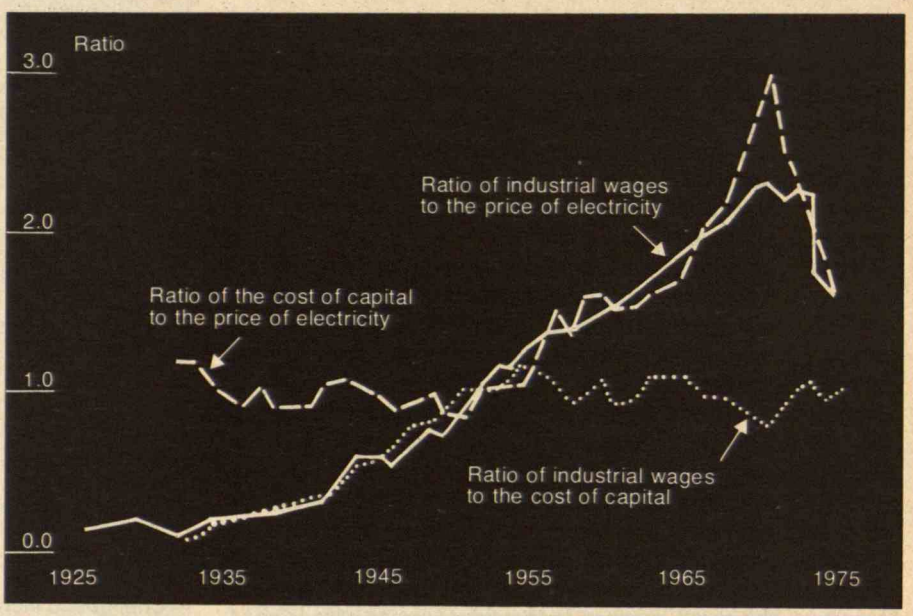
Changes to increase employment and decrease energy use (U.S. Economy; 1974)	New jobs per quadrillion new B.t.u. (saved) (940,000)
Changing from . . .	
. . . plane to train (intercity)	930,000
. . . throwaway to refillable beverage containers	750,000
. . . car to train (intercity)	700,000
. . . owner-operator truck to class 1 freight train	675,000
. . . new highway construction to health insurance (federal)	640,000
. . . car to bus (intercity)	330,000
. . . car to bus (urban)	210,000
. . . new highway construction to personal consumption	200,000
. . . car to bicycle	200,000
. . . plane to car	160,000
. . . plane to bus	140,000
. . . electric to gas stove	160,000
. . . electric to gas water heater	120,000
. . . electric commuter to car	110,000
. . . electric to gas clothes dryer	100,000
. . . frost-free to conventional refrigerator	60,000
. . . plush (25 appliances) to moderately-equipped (16 appliances) kitchen	30,000
. . . new highway construction to railroad and mass transit construction	30,000
. . . present to increased home (oil heat) insulation	15,000
. . . moderate to spartan (4-appliance) kitchen	10,000

Changes to increase employment and increase energy use (Average U.S. economy: 1950-1973)	Jobs gained per quadrillion B.t.u. lost (used) (1,620,000)
Changing from electric commuter to bus	530,000

Changes to decrease employment and increase energy use	Jobs lost per quadrillion new B.t.u. (saved)
Changing from . . .	
. . . black and white TV to radio	35,000
. . . present to new electricity supplies	75,000
. . . bus to bicycle	330,000
. . . car to motorbicycle	430,000
. . . color TV to black and white TV	1,750,000

Changes to decrease employment and ultimately increase energy use	Jobs lost per quadrillion B.t.u. lost (used)
Changing from . . .	
. . . beef protein to textured soy protein	720,000
. . . beef protein to direct bean consumption	860,000
. . . beef protein to complete soybean meat analog	970,000
. . . class 1 truck to container train	13,600,000

These are graphs of current dollar cost ratio indices of three principle inputs to production in the U.S.; wages are the manufacturing worker's hourly wage, the cost of capital is the interest rate on Aaa Corporate bonds, and the cost of electricity is the cost of an industrial kilowatt-hour. A rising slope means that there is an economic force to substitute the input represented in the denominator for the one in the numerator. (References: Edison Electric Institute; Moody, 1974; U.S. Department of Commerce.)



quad reduction in energy demand. During 1974 real compensation per man-hour declined 1.6 per cent, the real per capita gross national product dropped 2.9 per cent, and total energy use dropped about 2.1 per cent.

The table on page 49 contains only one example of increasing employment coupled with increasing energy use. The most interesting data point in this category is the rate at which the U.S. economy increased employment *and* energy use during the period 1950-1973. As shown in the chart on p. 51, during these years real compensation per man-hour rose 8.4 cents (1967) per year, real gross national product per capita rose an average of about 2.5 per cent per year, and total energy use rose at an annual rate of 3.6 per cent. Rising wages caused the substitution of energy for labor. Unemployment was controlled by increasing economic growth and by reducing the work time per worker. Both economic growth and energy use were driven by wages, which were rising relative to energy prices. The same effect is true for capital. Low-priced energy has tended to substitute for relatively high priced capital since about 1950-1955.

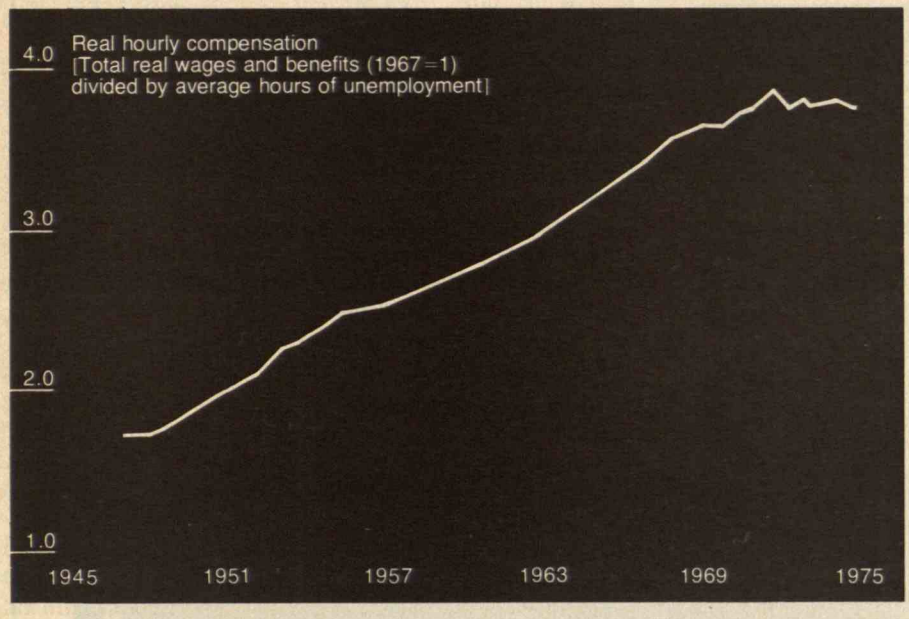
The third category of consumer options (*page 49*) contains activities in which jobs are lost while energy is expended. Most notable among these is the increase in electricity generation. Approximately 75,000 jobs are lost over the entire economy, in the short run at least, for each new quad of primary energy transformed into electricity. This happens because, in an equilibrium economy, the decision to purchase electricity requires a reduction in spending somewhere else. Although this spending reduction means a reduction in energy demand, it also means a reduction in demand for labor; and this reduction exceeds the number of jobs involved, directly and indirectly, in the purchase of electricity.

The bottom section of the table on page 49 includes those options which actually cause a job loss even though energy use would increase. The change from beef to vegetable protein would reduce energy consumption significantly, but the equilibrium effects of re-spending the large dollar savings would cause total energy consumption to increase.

All of the activities in this table were thought of as happening alone with an otherwise current or modern economy. But if they were occurring in sequence, the energy cost of dollar savings respent in the average way, would decrease with time. Conversely, the labor content of the average personal consumption dollar would tend to increase. This phenomenon would tend to abate the paradox given in the protein example and further enhance the job-producing and energy-saving qualities of the first set of activities shown in the table.

Strategies for Conservers

The conservers may wish to approach energy conservation on an activity-by-activity basis. Consequently, priorities would have to be established. Perhaps they



This is a graph of the change in real hourly compensation for the entire private business sector since 1947. It is found by dividing all wages and salaries plus all benefits by the total hours of employment and by the consumer price index. (Reference: U.S. Department of Labor.)

would use the table on page 53 as an aid in selecting among the first category of activities. It gives estimates of the total (direct and indirect) energy use for each activity as a fraction of total U.S. energy use.

Clearly, shifts from the personal auto to buses, trains, and bicycles would expand employment and reduce energy use, as would increased residential insulation to reduce heating energy losses. The reduction of bulk-materials trucking in favor of retail transport would have a similar effect. Operating and maintaining nondefense governmental programs seem to use little energy relative to the number of jobs created. However, government construction programs require more energy and fewer jobs, per dollar, than does the same dollar spent as personal consumption. In addition, these programs (highways, recreational reservoirs) seem to promote future energy dependency.

However, the shift to lower energy use could be produced more simply and consistently by a tax on energy. This process would work through the energy market: if energy were taxed as it left the ground, well-head, or hydropower dam, or as it was imported, on the basis of actual energy content, then the effects would filter through the economy and appear as increases in the cost of consumer goods and services. Naturally, the price of the most energy-intensive of these goods and services would increase the most. Consumers should respond by shifting their spending from higher to lower energy-intensive products, thus lowering the total energy demand and raising the labor demand for the average consumption dollar. The tax should gradually increase, relative to the unit costs of labor and capital, until a unit of fossil fuel costs as much as its renewable replacement.

Although such an energy tax would reduce energy use in home and industry, the tax would be income to the government and when spent, would make its own special energy demands. The tax also reduces personal disposable income. The energy tax could be returned as a reduction in personal income tax, thereby offsetting its inflationary effects.

The government could also use the tax to subsidize the initial capital requirements of energy conserving changes in industrial, commercial, and household sectors of the economy. The energy tax could be used especially to encourage full employment. An alternative to direct government spending is an offsetting tax reduction elsewhere which also encourages the productivity of energy and increases employment. Payroll tax reduction is an example.

Another alternative to promote energy conservation is the use of energy rationing. Rationing acquaints people directly with the finite aspect of energy (price increases due to an energy tax are obscure to the typical consumer). Theoretically, rationing guarantees each person an equitable amount of energy — the actual rate of consumption becomes a purely individual decision. Also, rationing is a more precise method of control over the flow of energy in

Cycling from Growth Into Stability

Superimposed upon the familiar short- and long-term cycles of expansion and contraction built into our economic system is a pattern of inexorable long-term economic change. All these work together, says Jay W. Forrester, Professor of Management at M.I.T., to cause what he calls "today's growing economic instability."

Many of the actions we propose to resolve our present economic melancholia will in fact exacerbate our problems, Professor Forrester told the Joint Economic Committee of the House and Senate late last fall.

Professor Forrester's computer studies of the national economic system suggest that three cycles are involved in economic fluctuations: the familiar short-term (three to seven years) business cycle, the longer-term Kuznets (20 to 25 years) cycle, and the Kondratieff (45 to 60 years) cycle of economic and political change (*see "Modeling Cycles in the National Economy," by Nathaniel J. Mass in* Technology Review *for March/April, 1976*). Preliminary results suggest that the short-term business cycle arises in the consumer goods sectors of the economy, through tardy feedback between production, inventory, and consumption. Cycles of over- and under-investment in capital goods are involved in the Kuznets and Kondratieff waves, says Dr. Forrester.

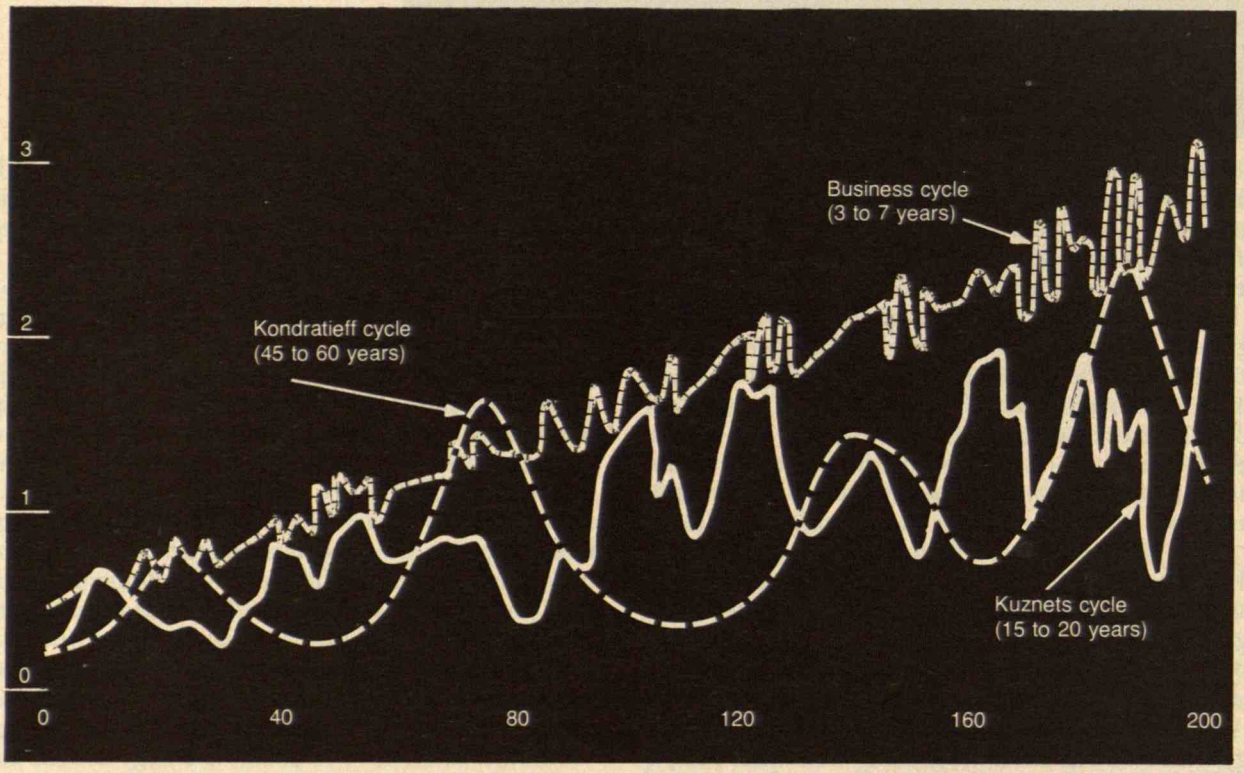
In the capital goods sector, for example, a large expansion to overcome accumulated shortages from the depression and war years followed World War II. By 1960, when capital plant was once more adequate, "tremendous forces" remained — in labor unions, banks and capital sector industries themselves — to sustain capital accumulation. Finally the momentum faltered, and a decade later, as capital plant became more and more excessive, there is probably so much capital that no new investment will be needed until the 1990s.

Professor Forrester explains "stagflation" this way: to encourage growth and reduce unemployment, the government is increasing the money supply and providing other incentives to new investment; but if capital plant is already too large, such increases and incentives lead not to plant expansion but to the inflation which they were designed to combat.

Over all these cyclical motions is what Professor Forrester calls the "life cycle of economic growth" — the 300-year pattern of national development and maturity in which growth first sweeps upward in an ever-steepening curve, then follows a straight line, and finally slows and ceases as demand begins to balance available resources.

In this sense, U.S. growth is now giving way to "some sort of equilibrium" as the nation encounters limits to its resources and environment. Thus, he said, the U.S. is entering the period of transition, and we may have as little as 20 to 30 years in which to solve the problems it brings.

Under these conditions, thinks Professor Forrester, it's counterproductive for government to promote continued growth in per capita output; the real problem is "how large a stable population we can support, and at what standard of living" — a hard set of trade-offs for which in this nation there is little precedent. — *J.M.*



A computer-based simulation by Professor Jay W. Forrester and his M.I.T. colleagues reveals cyclical behavior by much of the U.S. economy: labor demand in the consumer-goods sector in the three- to five-year business cycle, capital demand from the consumer-goods sector in the 15- to 20-year Kuznets cycle, and capital-equipment demand in the capital sector in the 45- to 60-year Kondratieff cycle. But Professor Forrester suspects that there is an even larger "life cycle of economic growth" which represents a 300-year process of maturation.

This table contains estimates of the direct and indirect energy demand of a variety of consumption activities in the U.S. for the period 1971-72. The sum of the items in this list would double count some total U.S. energy use, e.g., some personal auto use is involved in protein production. (References: Dole, 1975; Hannon, Harrington, Howell and Kirkpatrick, 1976. Hannon, Herendeen, Puleo and Sebald, 1975; Herendeen and Bullard, 1974; Herendeen and Sebald, 1975; Hirst, 1973; Penner, 1974; U.S. Department of Labor, 1976; U.S. Department of Transportation, 1972.)

Consumption activity	Jobs lost per quadrillion B.t.u. lost (used)
Transportation:	41.8
Personal autos	20.7
Urban autos	12.3
Intercity autos	8.4
Buses	0.3
Aviation (non-military)	3.4
Trucks	7.8
Rail	1.4
Other: pipeline, barge, rail transit, school buses and motorcycles	5.3
Military use	3.6
Government (non-defense)	7.3
Residential:	
Space heating	12.7
Clothes drying	0.8
Water heating	3.2
Cooking	2.2
Refrigeration and freezing	3.5
Beverage Industry (Savings of a full shift to refillables)	0.3
Protein production and consumption	3.0

the society than taxation.

Taxation and rationing promote a basis for self interest in energy conservation. At present, few individuals will volunteer a major reduction in energy use for the advantage of society, knowing that reduced energy use by one person will only depress the cost of energy enough to approximately cause the foregone amount to be consumed by others. Both energy taxation and rationing require a large governmental effort. But consumption of a finite resource is certainly an example of the inability of individuals to act in their own best interests.

In the U.S. today, those who advocate energy conservation are painted as advocates of economic force. But it seems to me conservers are those who wish to call an end to a consumption race which has no apparent finish line. They appear to be those who wish to exchange intellectual for physical complexity. They dream of a world in which influence and material wealth are inversely related. I hear them saying that the future was never more uncertain; that economic stability with declining energy use is an important goal, achievable with equity and full employment.

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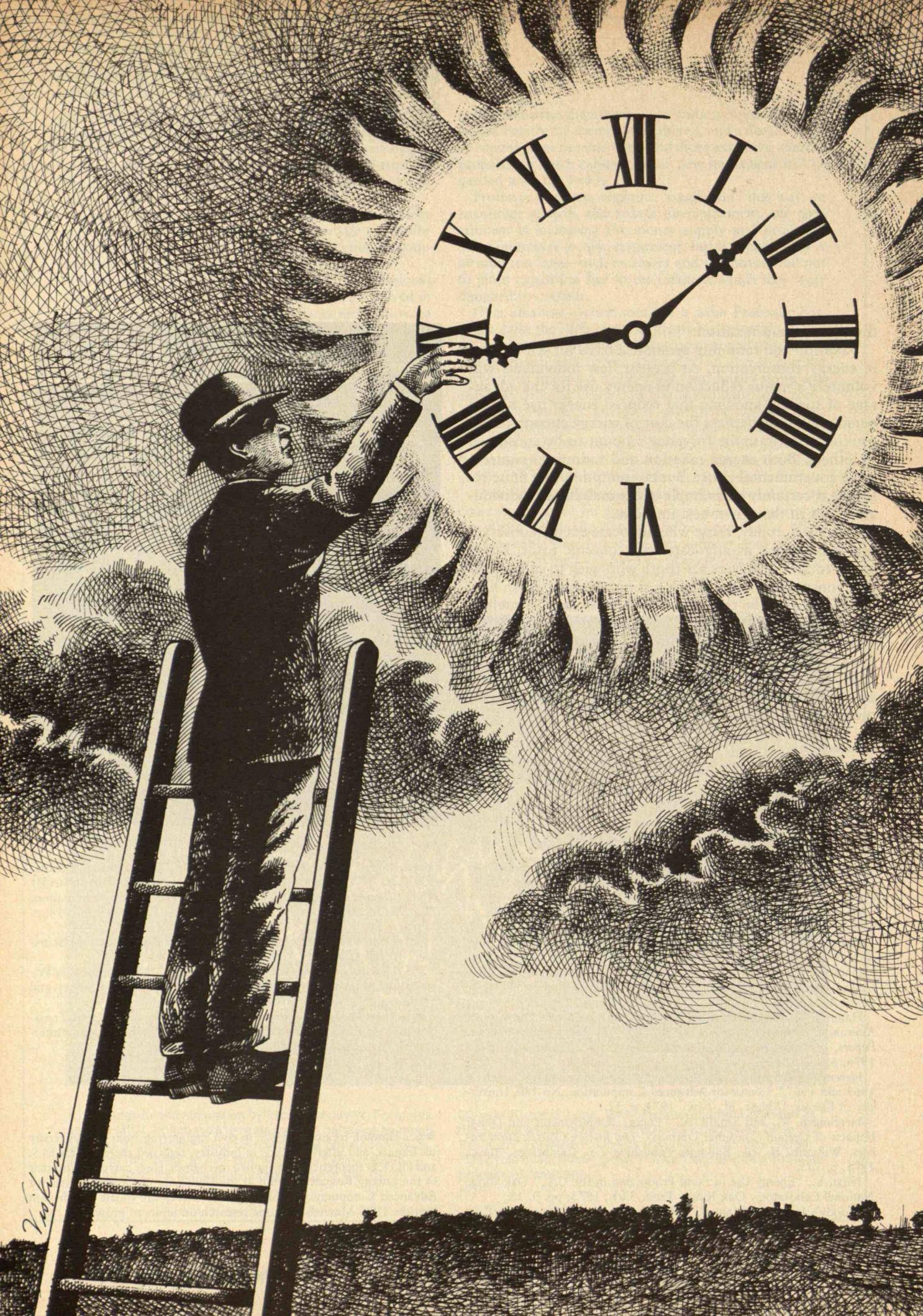


David S. Prerau
U.S. Department of Transportation
Transportation Systems Center

Changing Times: National Time Management Policy

Benjamin Franklin was astonished. "An accidental sudden noise waked me about six in the morning, when I was surprised to find my room filled with light. I imagined at first that a number of lamps had been brought into the room; but rubbing my eyes I perceived the light came in at the windows," he said in a letter to the *Journal of Paris*. "I looked at my watch, which goes very well, and found that it was but six o'clock; and still thinking it something extraordinary that the sun should rise so early, I looked into the almanac where I found it to be the hour given for the sun's rising on that day. Those who with me have never seen any signs of sunshine before noon, and seldom regard the astronomical part of the almanac, will be as much astonished as I was, when they hear of its rising so early; and especially when I assure them *that it gives light as soon as it rises*. I am convinced of this. I am certain of my fact. One cannot be more certain of any fact. I saw it with my own eyes. And, having repeated this observation the three following mornings, I found always precisely the same result."

This discovery gave rise to "several serious and important reflections." Dr. Franklin considered that had he slept to his usual rising hour, he would have slept six hours by the light of the sun, and in exchange have been up six hours the following evening by candlelight. Since the latter was a much more expensive light, he was induced by his "love of economy" to estimate how much could be saved by using sunshine instead of candles. For Paris, where he was residing, he calculated a saving of over 64 million pounds of candles every year. "It is impossible that so sensible a people, under such circumstances, should have lived so long by the smokey, unwholesome, and enormously expensive light of candles, if they had really known that they might have had as much pure light of the sun for nothing."

Giving the situation further thought, Dr. Franklin became possibly the first modern proponent of government action to change the hours of human activity to make the best use of daylight. He proposed, albeit not seriously, a plan to encourage the use of sunlight rather than candles. There should be a tax on all windows with shutters, the rationing of candles, and the firing of a cannon in every street at sunrise "to wake the sluggards effectively and make them open their eyes to their true interest." Fortunately for late-sleeping Parisians, the plan was never put into effect.

The basic goal of daylight-saving time is, like Dr. Franklin's morning cannon firings, to change the hours of human activity to make the best use of daylight — shifting official clock time forward and back as the pattern of daylight changes throughout the year. This has almost always meant a system whereby the official time is advanced by an hour in the spring and turned back by an hour in the fall. The goal of daylight-saving time has not been controversial — most people would like to use daylight to its maximum advantage. What has been controversial is the determination of what is the most advantageous use of daylight, and whether or not it should be accomplished by a shift of the official clock time.

Daylight-saving time (DST) was first seriously proposed in England in 1907 by William Willett, an English builder, member of Parliament, and member of the Royal Astronomical Society. In his famous pamphlet, "The Waste of Daylight," opening a campaign for the adoption of summer daylight-saving time in Britain, he wrote: "The brief period of daylight now at our disposal, between the hours of work and sleep, is frequently insufficient for most forms of recreation, but the daily addition of an hour after 6 o'clock in the evening would multiply several times the usefulness of that which we already have."

Willett originally proposed setting the clock forward by 20 minutes at 2 a.m. on each of four Sundays in April (for a total advance of one hour and 20 minutes) and setting it back by 20 minutes at 2 a.m. on each of four Sundays in September. However, this was soon modified to a system where the clocks were to be advanced one hour at 2 a.m. on the third Sunday in April and set back one hour at 2 a.m. on the third Sunday in September.

Willett's plan was introduced in Parliament in 1908, and a Select Committee of Parliament to which it was referred reported favorably, listing six principal advantages:

— "To move the usual hours of work and leisure nearer the sunrise;
— "To promote the greater use of daylight for recreative purposes of all kinds;
— "To lessen the use of licensed houses;
— "To facilitate the training of the Territorial forces;
— "To benefit the physique, general health, and welfare of all classes of the community; and
— "To reduce the industrial, commercial, and domestic expenditure on artificial light."

The opposition was sizable. Many ridiculed Willett, terming him a dangerous crank. Farmers complained that their cows follow sun-time, not clock-time. Commercial traders with Europe felt DST might interfere with trade. Those who dealt telegraphically with the United States objected to shortening the overlap of business hours. Sci-

Drawing: Gary Viskupic

Two surveys of public opinion found DST generally popular, though markedly less so for the winter months. The overall results of the two polls are shown at the right. An additional finding of the 1974 poll was that 38 per cent of those polled disapproved of YRDST, but less than 4 per cent disapproved of DST in April and September, and less than 11 per cent disapproved of DST in March and October. The 1975 poll showed DST most popular in the West (73 per cent of non-neutral responses) and East (71 per cent), and somewhat less popular in the Midwest (61 per cent) and South (58 per cent).

Survey date	DST system in effect	Public opinion of DST system: Including neutrals (per cent)			Excluding neutrals (per cent)	
		Pos.	Neg.	Neutral	Pos.	Neg.
March 1974	YRDST	54	38	9	59	41
March 1975	8-month DST	51	28	21	65	35

entists, businessmen, and others, who had just achieved (in 1884) a worldwide time-zone system, objected to the use of a non-standard time. Railroad men worried that DST might disrupt the railroads. Others said that one must change the people's habits, not the clock: "It would be more reasonable to change the readings of a thermometer at a particular season than to alter the time shown on the clock."

These objections carried the day, if not the daylight, and from 1907 to 1916 Parliament rejected several DST bills. Many of the same arguments have been reused each time DST has been proposed in Britain or the United States, up to the present day.

Time in War

While the British debated, Germany adopted daylight-saving time. Beginning May 1, 1916, Germany used DST to helps its World War I effort by conserving fuel. Under pressure of war, Britain and other European countries quickly followed. The British found that DST yielded greater production of war supplies, and health benefits as well as fuel savings.

At this time, the U.S. had little interest in Europeans' debate and decisions on time policy. The U.S. was not as yet in World War I, and time management policy had not yet been a subject for national legislation.

Through most of the 19th century, each community in the U.S. observed local solar time, setting its clocks to noon each day when the sun's shadow pointed due north or south. By the late 1800s, this plan was causing communications and transportation problems, especially for the railroads which met a different local time at each station. After years of waiting for congressional action, the railroads in 1883 adopted an independent system of standard time based upon four time zones, which we now call Eastern, Central, Mountain, and Pacific.

Each time zone was approximately centered on its "standard meridian" (a meridian being a great circle of the earth from one pole to the other). These were, respectively, 75°, 90°, 105°, and 120° west longitude, based upon a prime (0°) meridian which passed through Greenwich, England. The time at any point in the time zone was taken to be the mean solar time at its standard meridian. Soon all U.S. communities had adopted one of the four time zone standards, usually following the time used locally by the railroads.

After America entered World War I, accounts of DST's success in conserving fuel and increasing national efficiency in Europe led Congress to enact its first national time-management legislation, the Standard Time Act of 1918. This Act officially sanctioned a system based upon the railroads' time zone system (including a fifth time zone for Alaska) and provided for a seven-month period of daylight-saving time, from the last Sunday in March to the last Sunday in October. The Interstate Commerce Commission was empowered to adjust time zone boundaries and to govern time regulation but was given little authority for time standard enforcement.

At the close of the War, in 1919, daylight-saving time, thought of then as a wartime measure, was repealed by Congress over the veto of President Woodrow Wilson. Many had objected to it, especially farmers who had had to readjust their work schedules.

Between the World Wars, there was no national policy regarding daylight-saving time, and DST was left to local option. It was observed by a few eastern states and by many municipalities, primarily in the East and Midwest, each of which set its own starting and ending dates. In some areas strong opposition developed, and there was a continued shifting of municipalities on and off DST.

World War II brought renewed pressure for a national DST to aid energy conservation efforts. Most European countries adopted year-round DST; Britain went onto year-round double-daylight time — two hours advanced. In 1942 Congress put the United States on year-round "War Time," (compared to the seven-month DST of World War I) to help lower evening peak electrical power loads, which were greater in winter than in summer.

Time Out: After the War, Before the Crisis

When the War ended in 1945, the wartime measure was repealed, but interest remained high, especially in the East, and the popularity of DST spread. By 1965, some form of DST was observed in 18 states and in parts of 12 others.

Generally, DST was most popular in the Northeast and on the West Coast. But it was a patchwork pattern of states and localities having DST for different periods interspersed with states and localities not having DST at all, and confusion was inevitable. For example:

— A traveler going from Steubenville, Ohio, to Moundsville, W. Va., went only 35 miles; but during certain periods of the year, had to change his watch from daylight to standard time or vice versa no less than seven times.

— Minneapolis was sometimes on daylight-saving time while St. Paul was on standard time.

— In the state of Iowa alone, there were 23 different pairs

DST Transition	Change in electricity consumption in DST week vs. standard time week[1] (normalized)
January 1974[2]	−0.74
February 1975	−0.65
April 1973	−0.86
October 1972	−0.91
October 1974	−1.73

[1] Four days after the transition day vs. four days before for January
The week after the transition day vs. the week before for February and April
The week before the transition day vs. the week after for October

The D.O.T. studies of DST's impact on electricity consumption consisted of several analyses of the difference in electricity load between a time without DST and a similar time with DST. In one study, electricity consumptions for the week before a DST transition day were compared against the week following the transition day. The "equivalent day normalization" technique, which isolates the effect of DST on electricity consumption from weather, economic or other effects, was used. Each day is divided into two parts: a DST-influenced part (morning and evening) and a part uninfluenced by DST (near noon and midnight). If electricity consumption is found to change at a transition by a different amount in the influenced part of the day than in the uninfluenced part of the day, then the difference indicates a DST effect. Five different DST transitions were studied, and the results are shown in the top chart at the left. Below it, another study looks at the changes in national electricity consumption before and after 1967, the year when the Uniform Time Act went into effect, and several states employed DST for the first time. Other studies showed similar indications of a small reduction of electricity consumption due to DST.

	DST change at last Sunday in April	Per cent difference in electricity consumption week after vs. week before (non-normalized)
1963-1966	Some states change to DST	+0.26
1967-1973	Almost all states change to DST	−0.05
1974-1975	No change in almost all states (DST in effect before April)	+1.03

of DST transition dates in use in the same year.
— The State of Pennsylvania ran its official business on standard time while over 600 communities in the state were on DST.
— Parts of Montana were on DST, but state fishing licenses required anglers to fish on standard time.

Since the Standard Time Act of 1918 contained no provisions for general observance or enforcement of federal time standards, many communities had two time standards in effect simultaneously: a federal standard for activities governed by federal law (such as interstate commerce) and a local standard for everything else.

A Uniform Time Act (U.T.A.) was inevitable to correct the many faults, and it was finally achieved in 1966: all states were to be on daylight-saving time for six months, from the last Sunday in April until the last Sunday in October. Exemptions were allowed only for *complete* states, by acts of their legislatures; and legislatures of states that were in two time zones could exempt the entire area of the state lying within one of the time zones.

In addition, the U.T.A. added a time zone for Puerto Rico and the Virgin Islands and two additional time zones for Alaska, resulting in a total of eight covering the entire U.S.: Atlantic, Eastern, Central, Mountain, Pacific, Yukon, Alaska-Hawaii, and Bering. The Act also mandated greater enforcement powers to the Interstate Commerce Commission. These as well as all other time management functions, such as fixing time-zone boundaries, passed to the Department of Transportation when it was established in 1967.

The Uniform Time Act's nationally mandated six months of daylight-saving time caused a great deal of controversy. Several rural congressmen bitterly fought for a shorter period of DST. At that time, Congressman H. R. Gross of Iowa said "I am not going to vote today to make myself part of a tragedy on the highways of Iowa where school children, coming across the highway to catch a school bus in the darkness and semidarkness of late fall, are mowed down by a truck or a car . . . Let the blood be on your hands, not mine."

Senator Bobby Rowan, addressing the Georgia Senate, said "Not since Bible days has there been a man who could change sunrise and sunset, but the bureaucrats are attempting to do it." But, despite strong oratory about "God's Time," the bill was enacted by the Congress by a vote of about three to one, and very few states decided to exempt themselves from DST. By 1973, the only exempted parts of the contiguous United States were Arizona and the Eastern-time-zone part of Indiana. (Alaska, Hawaii, Puerto Rico, the Virgin Islands, and American Samoa were also exempted.)

The last Sunday in April to the last Sunday in October DST period proved to be generally popular, and this "Uniform Time Act Six-Six System" (six months on DST, six months off DST) continued until the energy crisis of 1973.

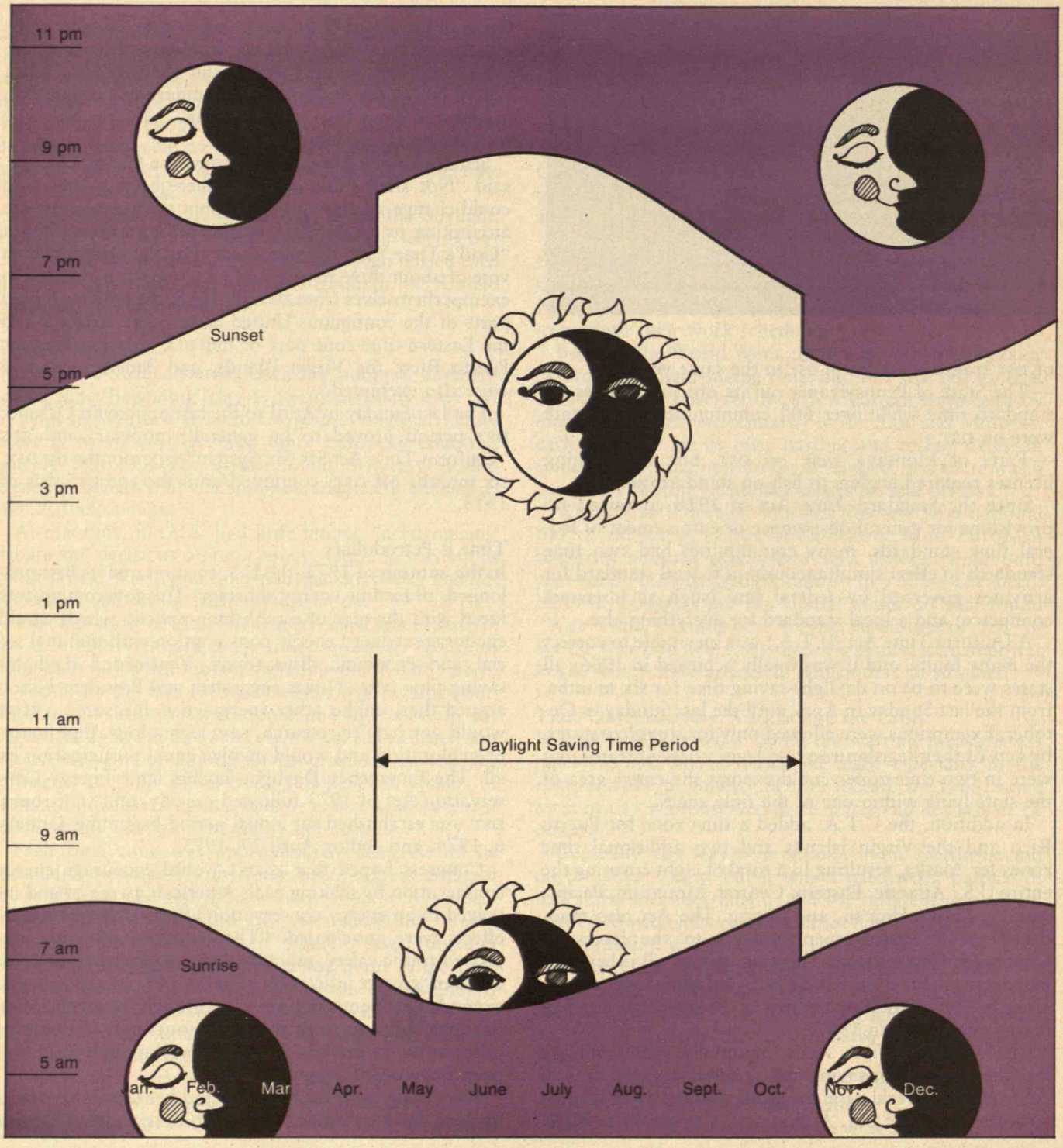
Time is Petrodollars

In the autumn of 1973, the U.S. encountered its first prolonged, peacetime energy shortage. The government was faced with the task of establishing policies which would encourage reduced energy consumption with minimal social and economic dislocations. Year-round daylight-saving time (YRDST) was suggested, and President Nixon argued that, unlike other energy-crisis measures, YRDST would not require research, new technology, diplomacy, or exploration and would involve equal participation by all. The Emergency Daylight Saving Time Energy Conservation Act of 1973 followed quickly, and year-round DST was established for a trial period beginning January 6, 1974, and ending April 27, 1975.

Congress hoped that YRDST would encourage energy conservation by making each American aware of and involved in an energy conservation effort. Other beneficial effects were anticipated: "The reduction of crime, improved traffic safety, more daylight outdoor playtime for children, greater utilization of parks and recreation areas, expanded economic opportunity through the extension of daylight hours to peak shopping hours and of domestic office hours to periods of greater overlap with the European Economic Community."

Since many of these hypothesized benefits of DST were unclear, the Department of Transportation (D.O.T.) was

The sunrise and sunset curves for a typical year shows the effect of daylight-saving time at the geographic center of the U.S.



The major sources of heat loss from a house are the conduction of heat from the inside to the outside, and the heating of cold air entering the house. Both these types of heat loss are approximately proportional to the integral of the temperature difference curve — the area between the inside temperature curve and the outside temperature curve shown above. A house with inside temperature settings changed at specified clock times would have its inside temperature curve shifted an hour by DST with respect to the outside temperature curve. However, the overall value of the temperature difference integral — the area between the two curves — would not change, as long as the outside temperatures remain below the inside temperature.

directed to study the operation and effects of the Act, and this work constitutes the most comprehensive analysis of the effects of daylight-saving time ever performed. It forms the basis of the following discussion.

Based upon the recommendations of the first D.O.T. report (the interim report), Congress amended the Act of 1973 to allow an eight-four system, with four months of standard time in the winter of 1974-75. When the Act of 1973 expired in April 1975, the Uniform Time Act (U.T.A.) again took effect. Unless a new DST Act is passed, all the U.S. is now stabilized on the six-six system of the Uniform Time Act, with DST from the last Sunday in April to the last Sunday in October.

Living by the Clock

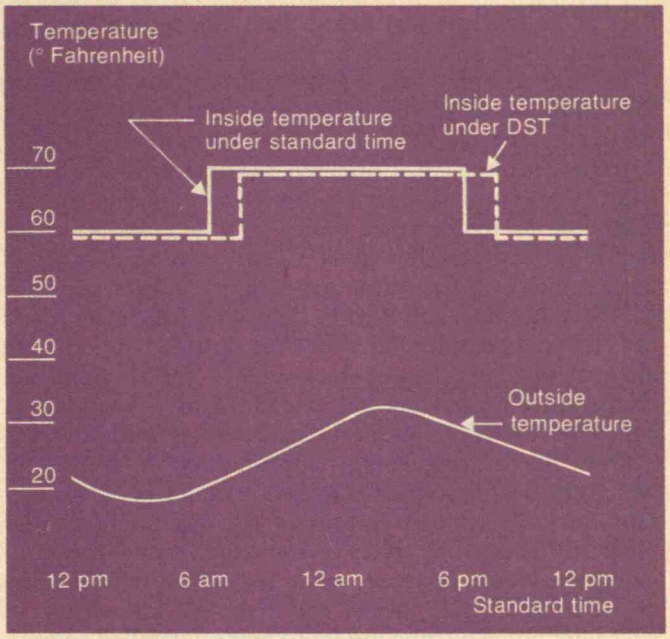
Daylight-saving time shifts clock time by one hour; activities which are clock-determined are shifted with respect to daylight. The result is a complex set of effects.

The shift of clock time of one hour causes a shift of one hour with respect to daylight for most factory and office workers and other "clock-oriented" persons. Rush hours under DST, for example, are shifted by an hour with respect to the sun; lighting conditions and requirements are changed. For "daylight-oriented" people, including farmers, construction workers, etc., for whom light is more important than clock time, and for persons not working, such as retired people and those on days off from work, DST need cause no change in major activities with respect to daylight. But there is a secondary effect on these people when these two groups interact; for example, farmers whose cows follow the sun must sell their milk to markets that follow the clock.

The effects of DST are complex and difficult to isolate. Even the effect of daylight on most activities is not well determined. Often two small opposite impacts are produced — one in the morning and one in the evening —making the net daily impact even smaller. And all these changes take place in the presence of much larger changes generated by seasonal patterns and institutional changes. No wonder, then, that predicting effects of DST on human activity and energy demand is so intricate.

However, the D.O.T. studies, using a variety of techniques, found indications of several consistent DST effects. Though these indications were not considered conclusive, they agree with reasonable expectations.

The impacts can be considered in four areas: energy, crime, safety, and socioeconomic behavior. There follows a summary of those results and suggestions of some plausible behavior changes that might have caused them.



Energy Impacts: Small Increments on Large Quantities

Daylight-saving time can affect energy consumption and, as we have seen, this has been a major reason for establishing DST during wartime. The extra hour of light in the evening under DST saves most households one hour of electric load due to lighting; but this saving may be wholly or partially offset by additional lighting needed in the morning. The net effect might be expected to be larger when the sunrises are earlier (towards June) and smaller when the sunrises are later (towards December).

Other DST impacts on electric load are less clear. However, several D.O.T. analyses indicate total savings of about 1 per cent due to DST in spring and fall and somewhat less in the winter. This would correspond to savings of 40 to 50 megawatts per day for the nation.

However, DST also could affect other forms of energy consumption. One can postulate, for example, that the extra hour of light in the evening could cause an increase in evening recreational and shopping travel by automobile (and therefore an increase in gasoline consumption) that might not be offset by a corresponding decrease in the morning. But D.O.T. did not detect any statistically significant increase in travel or gasoline consumption due to DST. This is not to say that none exists; the research techniques used were adequate to detect increases in gasoline consumption down to 0.5 per cent. But the im-

To achieve a sunrise-limited symmetrical system of establishing daylight-saving time, based upon the latest sunrise time occurring under the Uniform Time Act in effect from 1967 to 1973, the DST transition dates scheduling will depend upon the base latitude and the allowed tolerance (*right*). A system for the entire country (*far right*) could be based upon either the geographic center latitude (40° N) or the conterminious U.S. The first can be considered as taking the "average" for the country; the second is a worst-case approach based upon the extremes.

Latitude (degrees N)	Tolerance (minutes)			
	0	5	10	15
49	2/23-11/6	2/21-11/9	2/18-11/13	2/15-11/16
43	3/4-10/31	3/1-11/4	2/26-11/8	2/23-11/12
40[1]	3/6-10/31	3/3-11/4	2/28-11/8	2/24-11/13
36	3/9-10/31	3/5-11/5	3/2-11/10	2/26-11/15
31	3/13-10/31	3/9-11/6	3/5-11/12	2/28-11/18
25	3/18-10/31	3/14-11/8	3/9-11/15	3/3-11/23

[1] Geographic Center

pact of an increase just below this limit would have escaped analysis and would be significant.

DST affects home heating fuel consumption by shifting the sunlight (and the outdoor temperature patterns) with respect to the clock. Since desired indoor temperature patterns are often clock-oriented, the operation of a home heating system may have to change to maintain the desired indoor temperature under DST; but we postulate that the effect should be small. Clearly, DST will not affect houses in which the inside temperature is kept constant for the entire day, and even in cases where different levels of inside temperature (all above the outside temperature) are prescribed at different clock times — for example, one temperature for daytime and one for night — heating fuel consumption will be about the same with or without DST.

Only the heating energy consumption of houses in which the heating system is turned completely off for certain clock-determined periods of the day might be significantly affected by DST. For some such modes fuel consumption would increase, while for others it would decrease; and D.O.T. lacked the extensive knowledge of prevalent home heating modes to make a detailed computation of the net fuel consumption effects of DST.

Crime Impacts: Potentially Significant

Certain types of crime are generally assumed to be influenced by lighting conditions, and thus an increase in artificial lighting is often used as a crime deterrent. A shift of the sunlight pattern therefore might be expected to affect crime rates, especially those for outdoor crimes such as robbery, rape, aggravated assault, and auto theft and for indoor crimes involving an entry from outdoors, such as burglary. Indoor crime, such as shoplifting, should not be much affected.

The shift in daylight pattern may simply shift the commission of crimes by one hour. However, the interaction of the criminal and the mass of clock-oriented people may be different under DST, leading to a different crime rate. For example, more light in the evening may decrease the opportunity for street crime against downtown shoppers or theatre-goers; when darkness finally comes, fewer people will be on the streets as potential victims.

A study by the Law Enforcement Assistance Administration of crime in Washington, D.C., found that crime was consistently less during periods of daylight-saving time than during comparable standard time periods. Reductions in property crime were not statistically significant, but violent crime was down 10 to 13 per cent due to DST. If studies of crime in other cities were to confirm anything approaching this reduction in violent crime due to DST, then one could postulate an extremely significant national impact.

Safety Impacts: Safer in the Evening

The motor vehicle accident rate is generally lower in the daylight hours and higher at night. Since DST makes morning periods darker and evening periods lighter, the affected morning hours should have a higher accident rate and the affected evening hours should have a lower accident rate. Evening traffic density is significantly higher (often by a factor of two) than morning traffic density, so the total daily accidents may be expected to decrease under DST. This net effect will be influenced by DST-induced traffic pattern changes and will vary during the year as the DST light shift coincides to a greater or lesser degree with traffic peaks.

Studies by the D.O.T. found indications of a 0.7 per cent decrease in fatal accidents for March and April under DST compared with standard time and a 0.16 per cent decrease for January and February. These changes are small but important — the March and April decrease corresponded to a total of approximately 50 lives saved and 2,000 injuries avoided. Though much concern has been expressed about the effect of DST on the safety of children going to school, D.O.T. found that DST posed no special motor-vehicle-accident hazard to school-age children as compared to the total population, at any time of the day. This was true for pedestrian/pedalcyclist accidents, motor vehicle occupant accidents, and total accidents. A National Safety Council study of the effects of DST in March and April on pedestrian and pedalcyclist fatalities of school-age children going to and from school reported no trend above that for the general population; since morning accidents may go up under DST for the general population, the same may be true for school-age children. But for both groups, this seems to be more than offset by a decrease in evening accidents.

Socioeconomic Impacts: Reaching the Car Radios

Daylight-saving time might be expected to increase available recreation time. Morning recreational opportunities would be diminished, but these are less commonly utilized than evening activities. Weekends and vacations would probably not be affected. The detailed behavioral data needed to confirm these assumptions are not available, however. A survey by the Department of Interior was unable to detect any significant effect of DST on the utilization of parks and recreation areas.

Tolerance (minutes)	Geographic Center Latitude (40° N)	Conterminous U.S. (25°N to 49°N)
0	March 6 — October 31	March 18 — October 31
+5	March 3 — November 4	March 14 — November 4
+10	February 28 — November 8	March 9 — November 8
+15	February 24 — November 13	March 3 — November 12

Daylight-saving time has a clear impact on radio broadcasting. A-M radio signals propogate less during daylight hours than during the night, due to the effects of solar radiation on the atmosphere. Therefore, more stations can operate during the day without interfering with one another than at night. Thus there are about 2,500 local "daytime stations" are authorized to operate from sunrise to sunset.

About 500 of these are "secondary stations" which operate on the same frequency as a full-time station. They must shift their operation with the shift in DST daylight, and this shift will cause them to lose one hour's morning audience and gain one hour's evening audience. For most secondary stations, this means a net audience loss, as the morning "drive-time" audience lost is larger than the audience gained in the late afternoon. The audience loss, of course, generates a revenue loss for the stations. The Federal Communications Commission estimates that between January and April, 1974, DST caused revenue losses averaging $1,500 per daytime secondary station. But a more serious concern, says the F.C.C., is the curtailment of early-morning service to the public, especially in rural areas where a secondary station is often the only early morning broadcaster available to the community.

The impact of DST on general economic activity seems small. A survey of organizations in manufacturing, finance, domestic trade, construction, and public transportation showed DST impacts to be minimal in all fields. Most groups mildly favored DST or felt it had no effect.

The shift of clocktime under DST lengthens by one hour the overlap of business hours for foreign trade with Europe and shortens by an hour the overlap with Japan; thus trade with Europe may be facilitated while trade with Japan may be inconvenienced. However, no "trade window" exists between the eastern two time zones of the country and Japan even during standard time. A D.O.T. study of telecommunications showed no effect on communications with Japan under DST, but an increase in communications with Europe.

The Best Time to Change Time

Whether a long or a short period of daylight-saving time is desired, it is important to find good criteria for determining the transition days from standard time to DST and back again. One such criterion is "symmetry." The DST transitions under the Uniform Time Act Six-Six System are not placed symmetrically with respect to the day of maximum daylight (the longest day). In fact, while the fall DST transition is approximately 129 days after the longest day of the year, the spring transition is only about 55 days before it. Similarly, the transitions are not symmetric with respect to the day of latest sunset or the day of earliest sunrise. Rather, the transitions are approximately symmetrical about the warmest days of the year, which are at the end of July.

However, there are several reasons why daylight-saving-time transitions should be based upon light rather than temperature. Daylight-saving time changes the light pattern. Thus, DST directly affects light and not temperature. Most of the indicated positive impacts of DST discussed above (savings in electricity for residential lighting, reduction of crime, the decrease in motor vehicle accidents) have little to do with temperature or weather; they result primarily from the change of light pattern. Furthermore, since DST applies to the entire United States, it cannot be argued that it should be in effect only for "good-weather" months, because those months differ in different parts of the country. (Clearly, northern areas have longer winter-weather periods than more southern areas, and in some areas of the country the winter may be considered the "good weather" part of the year — the summer being rainy and/or very hot.) Accordingly, it seems reasonable that the transition to and from DST should be based upon the light patterns prevailing throughout the country, not upon temperature or weather considerations.

To base the DST system on light, a symmetrical system should be chosen so that days with similar sunlight patterns are treated alike.

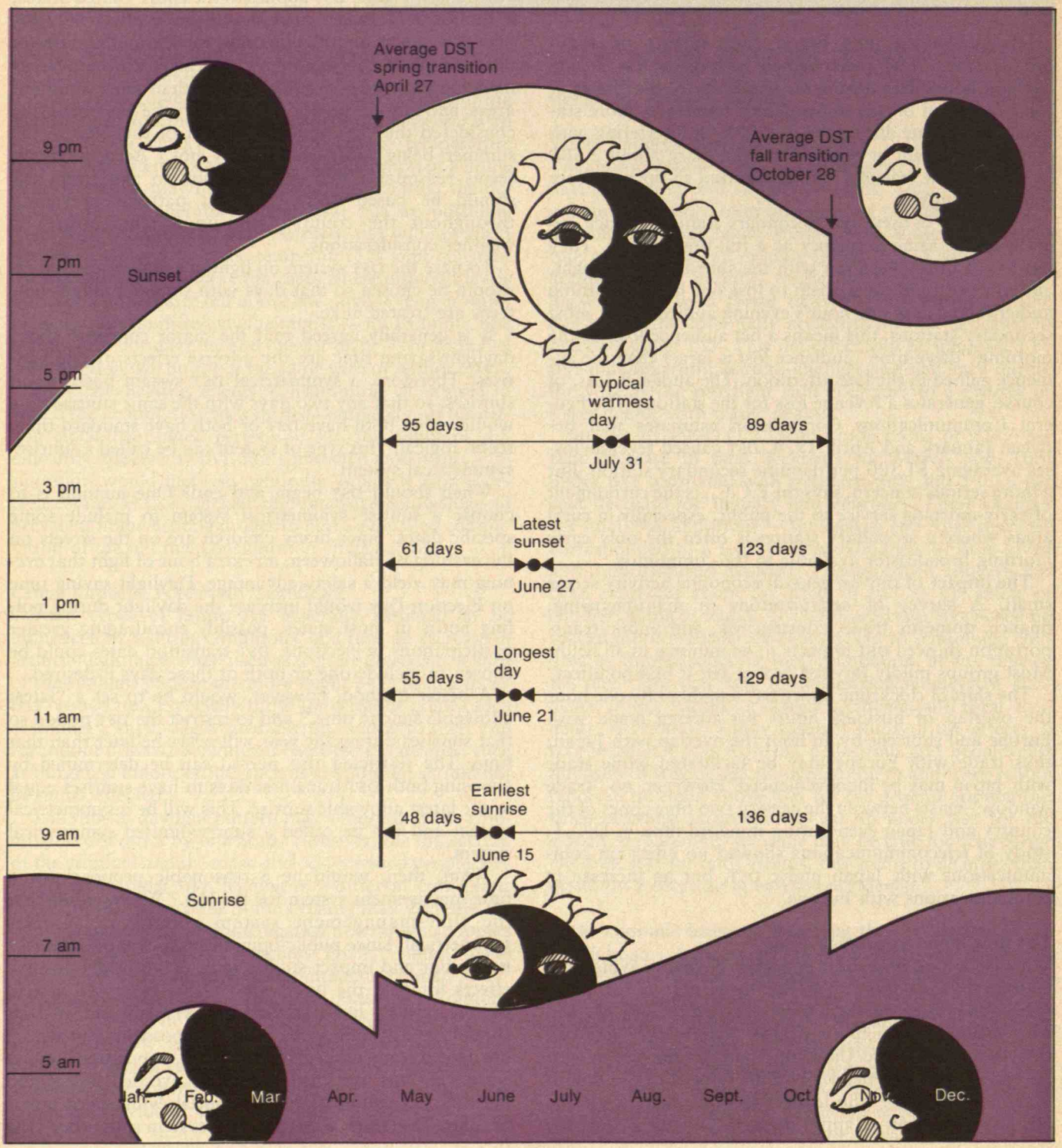
It is generally agreed that the major concerns about daylight-saving time are the adverse effects of late sunrises. Therefore, a symmetrical DST system based upon sunrises, so that any two days with the same sunrise time would either both have DST or both have standard time, seems logical. This type of system can be called a sunrise-symmetrical system.

When should DST begin and end? One method is to choose a sunrise symmetrical system to include some specific dates. Since many children are on the streets on the evening of Halloween, an extra hour of light that evening may yield a safety advantage. Daylight saving time on Election Day would increase the daylight during polling hours in most states, possibly encouraging greater participations in elections. DST transition dates could be chosen to include one or both of these days if desired.

A better method, however, would be to set a "latest allowable sunrise time," and to restrict the DST period so that sunrises during the year will never be later than that time. The restricted DST period can be determined by choosing both DST transition days to have sunrises equal to the latest allowable sunrise. This will be a symmetrical system and can be called a sunrise-limited symmetrical system.

What, then, would be a reasonable proposal for a time-management system for the U.S.? We conclude that the time-management system should be sunrise-symmetrical. Since public opinion surveys show that DST is popular and impact studies indicate generally positive effects for DST, the DST period of the proposed system should have no less DST than past systems and, in fact, should have as long a DST period as possible. But winter daylight saving time invokes strong opposition among certain groups and thus should be avoided unless and until impact studies show substantial evidence of major benefits. Therefore, a compromise system is in order. The

Under the Uniform Time Act Six-Six system, the DST system in effect nationally from 1967 to 1973 and in 1976, DST transitions were not placed symmetrically with respect to the day of minimum daylight: the chart shows DST for 40° latitude, 99° longitude — near Belleville, Kan.



people of the United States apparently have had no difficulty in adjusting to the sunrises under the Uniform Time Act Six-Six System, so a reasonable compromise time-management system would be a sunrise-limited symmetrical system which has no sunrise later than the latest sunrise under the U.T.A. Six-Six System, with possibly a small tolerance allowed. Since the shape of sunrise curves is essentially only a function of latitude (longitude changes merely shifting the entire curve four minutes for each degree of longitude), the transition dates chosen will depend upon the base latitude used to determine them. In the Boston area, the transition dates chosen by this method would be approximately March 4 and October 31.

Historically, DST transitions in the U.S. have taken place at 2 a.m. on Sundays, a very reasonable choice which has been generally accepted. The D.O.T. studies recommended a DST period from the first Sunday in March to the first Sunday in November. This choice gives eight months of DST, two more months than we now have. And yet nowhere in the country would the sunrise ever be any more than about fifteen minutes later than the latest sunrise under the U.T.A. Six-Six system.

A proposal for this DST system was before the U.S. Congress in February, 1976, but the Senate approved a daylight-saving time bill providing DST from the second Sunday in March to the second Sunday in October, a seven-month system with much more symmetry than the U.T.A. system. The vote was 70 to 23, with the opposition coming almost entirely from southern and plains states senators. The compromise seven-month period was favored over the D.O.T.-recommended eight-month period by a close (48-45) vote on an amendment to the bill.

In August, 1976, the House Interstate and Foreign Commerce Committee reported a bill providing for a seven-month DST period slightly different from that of the Senate bill — DST from the third Sunday of March to the third Sunday of October. The Senate eventually agreed to accept the provisions of the House bill. However, in the end-of-Congress rush in late September, the House required a two-thirds majority to suspend the rules and pass the bill. In a nearly-empty House Chamber, the vote in favor of the bill of 11 to 10 was not enough, and the bill was not passed. Opponents once again argued that an increase of DST to seven months placed hardship and inconvenience upon people in rural areas, restricted farmers, and increased hazards for children going to school.

The possible change to the Uniform Time Act Six-Six DST system may be taken up by the Congress in 1977 when it will be decided whether to retain the Uniform Time Act Six-Six System or to adopt an alternative system. Whichever decision is made, the system agreed upon will probably be the system in effect for the foreseeable future. In any case, it is reasonable to expect that the time management system for the near future will be a system based upon time zones approximately the same as our present time zones, with a DST period of six to eight months.

There have been some time management systems proposed that do not seem to have widespread support now, but may be given more consideration in the future. A single time zone for the entire United States has been proposed by a Defense Intelligence Agency researcher. Others have proposed a metric time system, with ten hour days. Each of these proposals has the virtue of simplifying the time management system, but would require more study. The author has proposed a four-period three-tier DST system, utilizing double-DST (clock advanced two hours). The system would be:

— December, January, February: Standard time
— March, April, May: DST
— June, July, August: Double DST
— September, October, November: DST

This system is, of course, more complex than the present system, but it utilizes more fully the summer's long hours of daylight.

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David S. Prerau received his Bachelor of Engineering degree from the City College of New York. As a National Science Foundation Fellow, he received his S.M. and Ph.D. degrees from M.I.T., specializing in computer science and pattern recognition. He is presently studying the application of computer science to transportation problems for the Transportation Systems Center of the U.S. Department of Transportation.

Trend of Affairs

The Washington Metro subway system represents a prime example of the gold-plated transit project, say critics. Rather than leaving the rock tunnel walls in their natural state as part of station decor (right), planners have specified expensive concrete waffle ceilings (below). Subway builders in Sweden use natural rock walls, saving a considerable amount of money in station construction. (Photos: Washington Metropolitan Area Transit Authority)

Trends This Month

TRANSPORTATION

The Overpriced U.S. Subway

Many of the hundreds of millions of dollars spent on mass transit are quite literally poured into a hole — a subway hole that is. So subway builders are vitally interested in getting the most hole for their money. According to a recent article by Gene Dallaire in *Civil Engineering*, the Journal of the American Society of Civil Engineers, U.S. subways, are not nearly so economically built as they could be.

The Washington Metro will cost $50 to $60 million per mile, and subways in Baltimore and Atlanta will run $30 to $40 million per mile. In sharp contrast, a recent 3.5-mile London subway extension cost about $18 million. Subway stations in the Washington Metro will cost $18 to $30 million, while Swedish stations typically cost about $2 million.

The reasons for the sharp cost differences lie both in the technology used and its management, said Mr. Dallaire. For instance, three new tunnel construction technologies — slurry walls, secant-pile walls, and precast concrete liners — have been introduced very successfully in Europe to hold down costs, but have seen little use in the U.S. Slurry-wall construction involves digging a narrow trench and filling it with steel-reinforced concrete. Two such parallel trenches are constructed, and the volume between them excavated

to create the tunnel.

Secant-pile tunnel walls consist of a series of poured-in-place concrete pilings, tightly abutting one another. Precast concrete liners are huge arch-like tunnel sections fitted into place after the tunnel is constructed.

Consulting firms and public transit authorities must assume full risk for problems that arise, so they have been reluctant to try these and other new technologies. Department of Transportation (D.O.T.) executive Russell McFarland argues that the federal government should assume some of the risks involved, and should insist that such new technologies be used where they are cost-effective. The D.O.T. should also establish a detailed review system for subway projects to assure that federal money is well-spent. The D.O.T. might even retain its own consulting firm to determine costs for a proposed subway system, and then agree to fund 80 per cent of that cost estimate, he suggests. D.O.T. currently funds 80 per cent of all new system costs without determining their reasonableness. The *Civil Engineering* article cites one instance in which a consultant for the Atlanta subway system insisted that his studies showed the "cut-and-cover" excavation method was the most economical for a certain section of that subway. When asked to produce his study, he could not, and subsequently changed his approach to tunneling, saving $1 million.

U.S. subway designers must also carefully review their designs with an eye to economics, said the article. For instance, station platforms' widths and lengths and tunnel sizes could be reduced to yield substantial savings. The London subway tunnels are 12.7 meters in diameter, vs. 16.7 for the Washington Metro. Construction could also be simpler. Stockholm's subway stations are built more cheaply because they are hollowed out of solid rock, and use the natural beauty of the rock as part of the station decor. In contrast, the far more expensive Washington stations use waffle-slab concrete ceilings, because, according to the article, the Washington Fine Arts Commission was intent upon building "monuments."

A final, important reason London subways are cheaper than proposed U.S. subways is that London has built its subway system piece-by-piece, benefitting from experience along the way. Washington, D.C., however, is attempting to build its 100-mile-long subway in a single swipe. The Washington lesson has apparently been learned in Baltimore and Atlanta; they are currently planning only small portions of what they eventually expect to build. — *D.M.*

Agenda for Survival of the Automobile

The automobile of the 1980s is supposed to average at least 25 miles per gallon of fuel and at the same time be comfortable, nonpolluting, and safe. These goals impose conflicting strategies on automotive designers, and they may impose some painful compromises on customers. But they can be achieved on the basis of technology available or foreseeable today, says a federal task force under the management of Hamilton Herman, former Assistant Secretary of Transportation.

What of the 1990s, when the automobile has to be a useful part of a world which is harder to foresee? The answer to that question depends on an ingredient which is now missing — "long-range research . . . a fundamental knowledge base and new transportation concepts," says a task force of the American Society of Mechanical Engineers.

Nothing Revolutionary

Three strategies will lead to the economy of cars in the 1980s: advanced engines, including a light-weight diesel and perhaps a gas turbine; innovative structures in which plastics and aluminum substitute for 10 to 15 per cent of today's steel; and up-graded drive trains using four-speed automatic transmissions with locking torque converters to prevent slipping. With these improvements, new cars built by 1985 will show fuel economy 80 to 100 per cent better than today's.

The federal task force did not predict "revolutionary new engine technologies" or electric propulsion for the 1980s, the prospects for a "highly efficient" electric car being deemed "slim" for at least the next decade.

Increasing auto safety in the 1980s hinges on widespread use of seat belts (if seat belts were used 70 per cent of the time, fatalities and serious injuries would drop instantly from 43,000 [1976] to 35,000 a year) and new construction to meet new safety standards. The latter will increase car weight slightly and so will impose a small penalty on economy and performance.

The problem of further reducing engine emissions is the hardest to quantify, says the federal task force, because it depends on incomplete technology. At a minimum, the task force counts on substantial benefits from a program of nationwide inspection. The most pessimistic estimate is that new technology for reducing emissions in the 1980s might impose a 6 per cent penalty in fuel economy.

A New Look from the Ground Up

What happens to the automobile in the 1990s? Here are some examples of the research advocated by the A.S.M.E. task force, headed by Herbert H. Richardson, head of the M.I.T. Department of Mechanical Engineering:

— Our highway transportation has grown a little like Topsy — no grand design at all. Professor Richardson and his colleagues think an unconstrained review of this vehicle-fuel-refinery-highway system might show some important ways of saving fuel and reducing pollution, noise, and accidents.

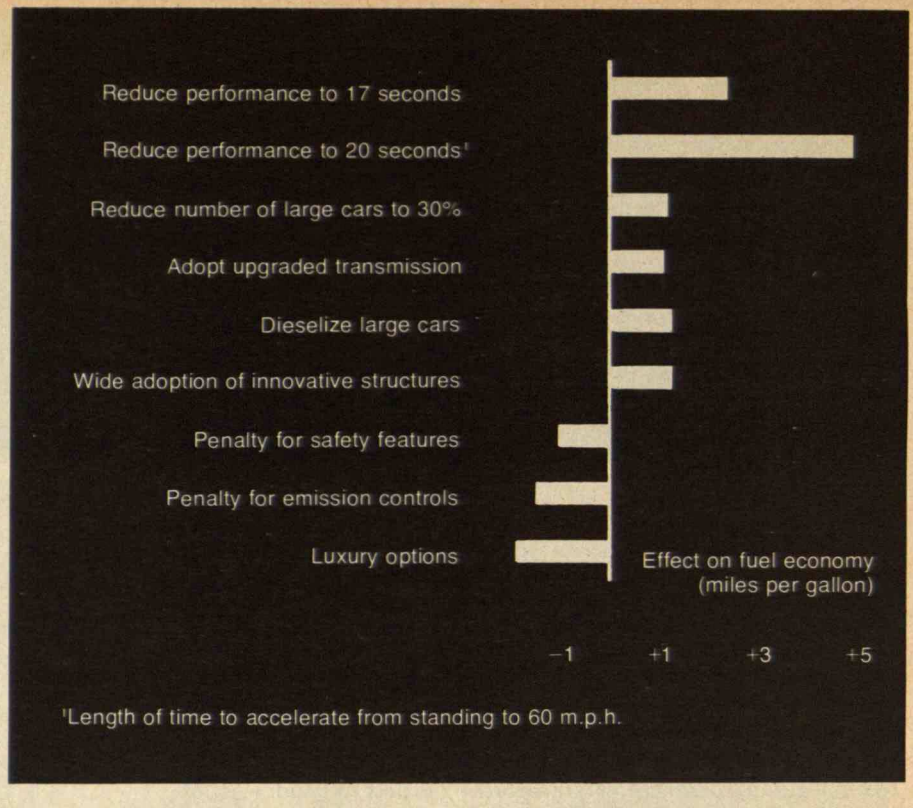
— Motor vehicle maintenance is a big U.S. industry — $26.5 billion in 1975, and growing. But there's not enough serious, fundamental study of how the amount and cost of the service required by our automobiles could be reduced — of failure modes and their effect on accidents.

— Mechanical engineers ought to take a long, hard look at how automobiles could treat their passengers (and cargoes) better on rough roads and especially in crashes. The interface between vehicle and high-

way is a complicated one, and the task force proposes "advanced research on nonconventional vehicle suspensions (such as magnetic levitation)" and on "human body mechanics in relation to injury and discomfort."

— Can modern controls, monitoring, and management — i.e., on-board computers — increase the capacity of our highway system, making it safer and its vehicles better citizens? No one knows, because no one has looked fundamentally at steering, power transmission, braking, and carburetion.

If the federal investment in transportation is some $8 billion a year (1976), then more than $500 million of it ought to go into transportation research, thinks the task force. — *J.M.*



New cars produced in 1985 could average 25.2 miles per gallon over a full range of models if technology known today — advanced engines, light-weight structures, and more efficient transmissions — were adopted by manufacturers at reasonable rates, according to a federal task force study of motor vehicle goals beyond 1980. To achieve better results — say, 27 to 30 miles per gallon average for an entire range of subcompact (25 per cent of sales), compact (25 per cent), and full-size vehicles (50 per cent), a manufacturer would have to take some of the options shown above. And he faces the possibility that emission and safety standards will force adoption of designs which reduce economy. The 25.2 m.p.g. figure does not include such luxury options as air conditioning and extra heat and sound insulation, widespread use of which would also set back the economy effort.

Detroit Learns New Materials Lessons

Under federally mandated fuel economy requirements, auto makers have already "downsized" their products, but this remedy will only go so far. New materials promise to help considerably on the road to fuel economy.

Before the current auto materials revolution ends, Detroit will be providing the average consumer with glued-together, super-plastic, fiberglass, epoxy-resined, aluminized future cars, that weigh half as much as their steel predecessors. Articles in last December's *Automotive Industries,* an industry journal, detailed the switch to new materials.

Plastics engineers predicted that the 1985 auto will be 40 per cent plastics by volume, and aluminum proponents see a correspondingly promising auto market for their material.

Auto manufacturers are first learning their plastics technology on small parts — splash shields, fan guards and minor exterior parts. However, in a few years they plan to graduate to plastic structural members, doors, rear decks, hoods, and fenders. The slow evolution is necessary because plastic behaves much differently in forming presses than does steel, tending to spring back to its original shape. The auto makers must learn the correct temperatures, pressures, and "dwell times" of the presses, for instance, before they can proceed with mass production.

Another promising category of materials is composites, such as plastics reinforced by strands of fiberglass or graphite fibers. Now used in golf clubs, airplane wings, and other high-strength applications, composites offer even greater strength than plastics for structural applications. Auto manufacturers are still in the testing stages with these materials.

Although composites can be as strong as steel, these new materials stretch differently, and their strength properties depend very much on how the fibers are oriented and where they are embedded in a plastic part. But the future is promising. For example, Ford Motor Co. has been experimenting very successfully with an epoxy resin-graphite composite driveshaft, which weighs only about 5 pounds, a vast improvement over the 18-pound steel driveshaft currently used.

Automobile engineers are much farther along in their campaign to replace the traditional lead-tin solder used extensively to join auto body sections. Chrysler Corp. has just begun to use a plastic solder to join fenders, etc. under paint. The solder, an epoxy resin, is squeezed through a nozzle — which combines the two chemical components of the solder — and then is heat-cured. Besides the weight saved (seven pounds per car for a full-sized car) use of plastic solder eliminates the problem of toxic lead in assembly plants. The solder also joins different metals better than lead-tin solder, and remains more flexible under paint at low temperatures.

Aluminum is also challenging traditional steel as an auto material. New alloys are enabling construction of numerous aluminum engine parts, and in the case of the Olds 88, an aluminum hood. Just as the switch from steel to plastic raised new manufacturing problems, so has the switch from steel to aluminum. Molds must be covered with Teflon to prevent scratching of the metal, parts must be redesigned to allow for aluminum's inability to take sharp bends, and welding aluminum presents more problems than welding steel. One major blemish on the record of aluminum in autos has been the infamous Chevrolet Vega aluminum engine block, which presented its owners with severe durability problems. According to *Automotive Industries,* "a new competitive cast-iron engine being introduced by Pontiac could sound the death knell for the Vega aluminum engine."

While the new materials in autos are receiving most of the attention, Detroit is also quietly figuring how to trim pounds off its steel components. For instance, a new Pontiac engine features a redesigned engine block with thinner walls and the removal of non-functional metal. The result is a savings of 127 pounds over the engine it replaces.

The materials revolution in autos will be subtle, but steady, with new materials being phased in little by little. So the customer of 1985 will not be too surprised to find big cars weighing what small cars did in the 1970s. — *D.M.*

The Alaska Pipeline: Where Zero is Up

Workers building the Alaskan pipeline toil in an alien world. Earth and water are either rock-hard in winter or soup-soft in summer. Huge portable furnaces blast heat into the air around work sites to fight the winter cold, yet six months later the temperature is in the uncomfortable 90s. Night is endless at midwinter, and daylight is endless at midsummer.

In a recent issue of Fluor Corp.'s magazine, writer Pepe Lobo described how the environment affects men and machines. Not an inch of skin can be exposed to −75° cold, and bare skin and metal freeze together instantly, he writes. Although workers on the pipeline are carefully trained in how to dress, even the best clothes are useless if wet or greasy. Bulky cold-weather clothes make workers physically larger, with unfamiliar bulges to catch in machinery. With a hood pulled around a hard hat and ears enshrouded in muffs, a worker becomes blind and deaf to the dangerous world of ice and machines.

Large amounts of food are needed to keep up body heat, and large amounts of water are also needed to combat dehydration in the frozen, dry atmosphere.

The winter environment takes its toll on productivity; estimates of productivity for outside work range from 10 to 50 per cent of normal. And then there are the white-outs — wind-driven snow and fog that can reduce visibility to a few feet. Workers are often trapped in their trucks for days, unable to drive because even the end of the hood is not visible.

Materials also suffer from the environment. One mechanic, Norm Hisey, described the nightmare: "It's crazy. You have a lot of metal crystallizing — breaking — at stress points. On a Cat, it'll be the edges of the 'dozer blades. We've cracked four-inch metal. We've broken ripper shanks three inches thick and 11 inches across. We twist off two-inch steel shafts like they're not even there.

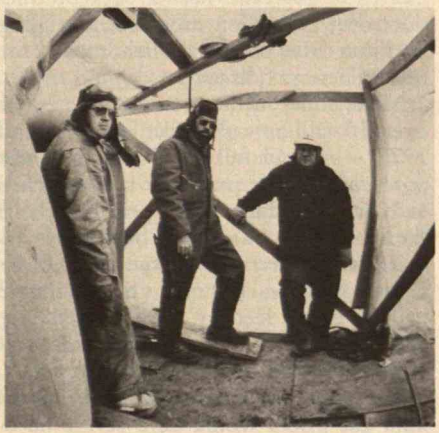
"Oil breaks down," says Hisey. "There's no lubrication in it; it freezes and the pumps won't pick it up. The fuel freezes in the tanks. Rubber gets hard. If a truck hits a rock or piece of sharp ice, big chunks come out of the tires. Plastic doesn't stand a chance up here. . . . At 60, 70, 80 below you just touch it and it breaks completely apart.

"There's a lot of windshield breakage, too," he said. "The glass is cold; and if you put a bind on the equipment, say going down a hill, it'll just crack. U-bolts and springs get so cold they break hitting a bump." Hisey estimates that they have experienced 70 per cent more equipment breakage than normal.

To combat the cold, the vehicles are kept running 24 hours a day, and when that is not possible, electric heaters warm the engines. Since concrete can only be poured at above-zero temperatures, workers must build protective buildings around the molds, and install thermometers within the pouring to assure the material stays above freezing.

In such cold, it is ironic that the pipeline company must buy refrigeration units. Where the pipeline burrows underground, to allow for wildlife to cross, the engineers must refrigerate the area to prevent the hot oil from melting the permafrost.

And finally, there's the snow. Valdez gets about 30 feet of snow a year. When asked if it was possible to lose tools in the snowfall one superintendent laughed. "You can put a 40-foot bus down and lose it. I know — 'cause we did!" — *D.M.*



Workmen on the Alaskan pipeline, muffled against the cold, perform in an alien environment, where both humans and materials can react in totally unexpected ways. Metal shatters, plastics disintegrate, and skin and tools can freeze together in an instant when exposed to −75°F. (Photos: Pepe Lobo/*Fluor Magazine*)

Miner's Canary for the Nuclear Age

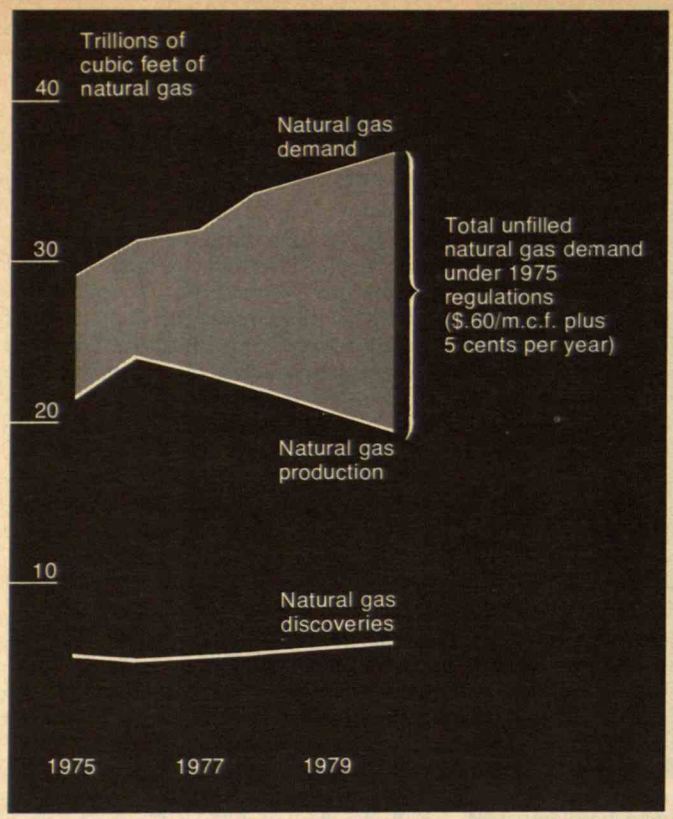
The scruffy, second-growth woods around the Pilgrim Station of Boston Edison Co. on the shore of Massachusetts Bay south of Plymouth are home to a bird population — perhaps 70 species — which far outnumbers the population of human beings in the same area. The birds have more free access than humans to the environs of the Pilgrim Station, a 760-megawatt boiling-water reactor. They depend on the woods for food and habitat, and their metabolic rates and food intakes are high. Could they serve as sensitive accumulators of radionuclides (if any) in the ecosystem surrounding the Pilgrim Station?

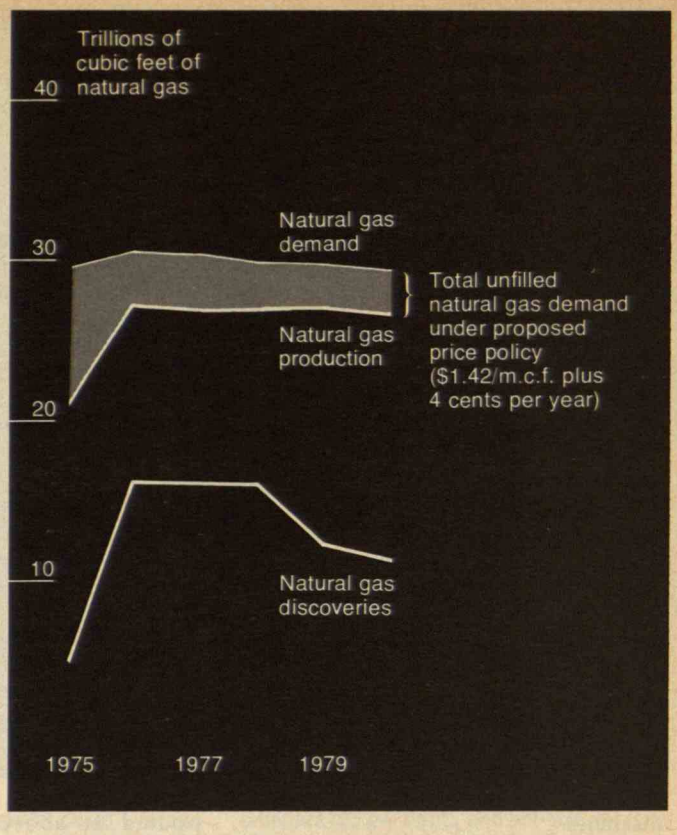
After more than five years of trapping, scanning, and releasing resident birds, three scientists associated with the Manomet Bird Observatory, located just two miles from the Pilgrim Station, are convinced that wild birds can be used to assess radioisotopes in the environment. The data (the project was sponsored initially by Boston Edison Co. and principally by the Energy Research and Development Administration) show that, with but a single exception, the Pilgrim Station contributed little or nothing to environmental radioactivity between July, 1971, and February, 1975, as measured in birds.

C. K. Levy, K. A. Youngstrom, and C. J. Maletskos worked with 6,000 individual birds of 70 species — mostly blue jays, bobwhites, mourning doves, and catbirds, but there were even some grouse and ducks — taken alive in nets at three locations: near the Pilgrim Station, at the Observatory, and at a control area 12 miles away. The birds were measured, banded, and released, and many were netted and remeasured repeatedly; the latter were the "stars" of the project, because they were known to be residents, constantly exposed to whatever was in the environment. The measurements were made (without injury to the birds) in a specially designed whole-body gamma-ray counter.

Body burdens of cesium-137 were found to be highly variable, changing by factors of two or three within two weeks; the fact that no cesium-134 was found led scientists to attribute the cesium-137 only to atmospheric weapons testing. The cesium-137 levels were in general three times higher in birds resident at the control site than in those captured repeatedly near the reactor. The differences are "real and significant," said the scientists in their report to the Fourth National Symposium on Radioecology, but no one can prove their sources.

Iodine-131 was found in birds at the reactor site on three occasions — each of about three days' duration — during two





The increase in the price of natural gas in interstate commerce — from 60 cents (left) to $1.42 (right) per thousand cubic feet — proposed by the Federal Power Commission in 1976 has everything going for it, according to simulations by Professor Robert S. Pindyck and his colleagues in the Sloan School of Management using the M.I.T. natural gas model. Unfilled natural gas demand would be reduced sharply throughout the rest of the decade, and new discoveries would be increased.

months when the reactor was shut down for repair and refueling early in 1974. The scientists believe that iodine-131 was released when the reactor containment vessel was opened during the refueling operation, but the release was so low as to be undetected by the Pilgrim Station's own monitoring equipment.

Zirconium-95 and niobium-95 were identified in a number of species, their appearance correlating with announced dates of Chinese atmospheric nuclear weapons tests.

The results suggest strongly that local bird populations have something to say about the environment — including, in this case, some reassuring confirmation of the integrity of nuclear reactor containments. But the scientists think they have only begun to understand the unique problems and opportunities of using these free-flying, recapturable environmental monitors. — *J.M.*

When Gas Goes Up

Recognizing that U.S. natural gas shortages are largely the result of regulated prices set too low, the Federal Power Commission last year proposed that the price of natural gas be raised immediately from 60 cents to $1.42 per thousand cubic feet. A chorus of wails from gas users sent the proposal into the courts and cooled F.P.C.'s ardor; meanwhile, the M.I.T. computer model which more than a year ago demonstrated the advantages of an increase in gas prices has confirmed the wisdom of F.P.C.'s policy.

The price of $1.42 would promptly reverse the recent trend of growing natural gas shortages, aggravated by the abnormally cold winter of 1976-77, says Robert S. Pindyck of the Sloan School of Management. Within two years there would be increased domestic natural gas production: over 26 trillion cubic feet, including 5 trillion cubic feet from offshore; and the rate of new gas discoveries would triple.

Meanwhile, demand — estimated at over 30 trillion cubic feet in 1976 and 1977 — would fall slowly as gas users economized their processes and switched to more abundant, lower-priced fuels. If the real prices of oil and other fuels remain stable (*see above*), the unfilled demand for natural gas might be less than 2 trillion cubic feet by 1980. Prices approaching $2 per thousand cubic feet would eliminate the shortage completely.

For low-income homeowners to whom high gas prices would be a severe hardship, Professor Pindyck suggests on "energy stamp" program patterned after today's food stamps. The cost to protect 20 per cent of gas users from the $1.42 price would be about $2 billion a year, far less than the high social cost of unemployment and displaced jobs caused by today's shortages, he says. — *J.M.*

Build A Solar Still

If your oceanside location is too dry (20,000 miles of coastline in the world is too arid for farming) the University of Hawaii suggests you build a solar still greenhouse.

Use hollow-columns of galvanized iron, perforated at intervals with two-inch holes, at each corner and at six-foot (approximately) intervals along the sides. Fill the columns with small stones or coral chips. Frame the rest of the greenhouse conventionally in wood or galvanized iron, and cover the frame with glass or transparent polyethylene.

Set a black fiberglass pan two inches deep and almost as large as the greenhouse itself on the rafters. Use an automatic pump to keep this pan full — perhaps one inch deep — of sea water. Once a day pump all the water out of the pan and refill it with fresh sea water.

As the sun shines on the pan, the water will evaporate and this pure water will condense on the inside of the greenhouse roof. From there it will run into the hollow iron columns. As the water percolates down through stones or coral chips in the columns it will bathe the roots of plants set in the column perforations.

A 12-by-12-by-13-foot greenhouse built on Oahu, with an 8-by-8-foot pan two inches deep, distilled on the average three liters of water a day during a four-

day period when the Hawaiian sky was more than half covered by cloud. In that greenhouse 256 square feet were available for planting — 77 per cent more than the floor area of the greenhouse. Tomatoes, eggplant, radishes, and cucumbers are the recommended plantings, according to T. W. Speitel, B. Z. Siegel, Jane Massey, Willie Cade, and Anne LaRose; they're all in various departments at the University of Hawaii, and they described their solar still greenhouse to ocean science experts at last fall's annual meeting of the Marine Technology Society. — *J.M.*

Aiming for More Coal Efficiency

Though some experts argue that we may never get around to using it, most people think of coal as America's "ace-in-the-hole" energy supply: we have lots of it, we use it to make electricity, and we know how to use it for synthetic gas and oil.

But what should be our strategy for using coal, and what research is needed to make our immense coal resource most useful for generating future electricity?

To focus attention on the most important research objectives, the Energy Research and Development Administration two years ago commissioned teams from Westinghouse and General Electric to design ten different coal-fueled power plants and figure the cost of power from each. The result: two new technologies, available "in the near term," can lead to "significantly lower cost of electricity and improved overall efficiency," and two more advanced technologies promise even higher efficiencies in the long term.

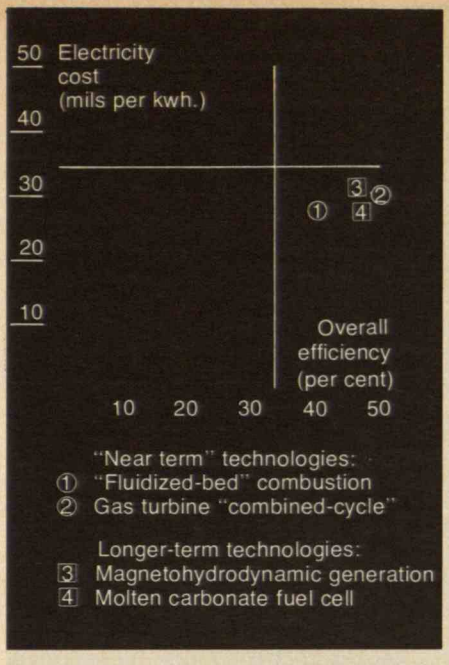
The two promising near-term technologies on which development work should be concentrated are:

— "Fluidized-bed" combustion of coal in conventional power plants. Powdered coal is burned in a special furnace while suspended in a stream of hot gas, the gas containing oxygen for combustion and calcium for removing sulfur from the stack gas. Efficiency may be as high as 40 per cent.

— "Combined-cycle" plants in which gas from coal is burned to turn a gas turbine which itself produces electricity and whose exhaust gas is hot enough to make steam to turn a conventional generator for additional power. Nearly 50 per cent efficiency was proposed by the Westinghouse team for such a system.

The two longer-term, more exotic high-efficiency options are:

— Coal-fired magnetohydrodynamic generation, with hot exhaust gases from the MHD generator used to power conventional steam generation. The MHD principle depends on using the coal to make a hot ionized gas, which produces current upon passing through an intense magnetic field. Efficiency: 45 to 50 per cent.



E.R.D.A.'s Energy Conversion Alternatives Study has identified four coal-based power generation technologies as promising increased efficiency and — perhaps — lower cost. The crossed lines represent figures typical of conventional coal-fired generating plants — 34 per cent overall efficiency, electricity cost of about 38 mils per kilowatt-hour.

— High-temperature fuel cells using gas from coal. Electricity would be produced by a chemical reaction between molten carbonate and the fuel gas with a possible 50-per-cent efficiency.

Reporting these results of E.R.D.A.'s Energy Conversion Alternatives Study, Steven I. Freedman and John N. Eustis of the Administration's Combustion and Advanced Power Development Division record special enthusiasm for the "near-term" systems because they meet all emissions requirements — a hard test for efficient, coal-fired power plants. They say that — whatever the future of nuclear power — utilities will need fossil-fueled units to supply power during those times of day when demand is highest. It's for this so-called "intermediate" service that the combined-cycle and fluidized-bed plants look especially attractive, because they can be powered up and down quickly. — *J.M.*

ECONOMICS

Economists Predict a Nuclear Future

Whatever the doubts about nuclear proliferation and safety, the economics are clear: 63 per cent of New England's electricity will be generated by nuclear energy in 1985 and at least 75 to 80 per cent of it by 1995. Overall, throughout the U.S., lower cost will make nuclear energy the fastest growing source of electricity, too: the nation as a whole now relies on nuclear energy for only 10 per cent of its electricity, but that figure will rise to 37 per cent in 1985 and 51 per cent by 1995.

These results come from the M.I.T. Regional Energy Model (R.E.M.), which incorporates predicted changes in technology and economics into a computer-based analysis; its authors are Paul L. Joskow, Associate Professor of Economics, and George A. Rozanski, a graduate student in the Department.

The R.E.M. analysis is based on the predicted future demand for energy in relation to the costs of coal, oil, gas, and uranium in nine regions of the U.S., and it also includes predicted costs of new construction, capital, power transmission facilities, and plant operation.

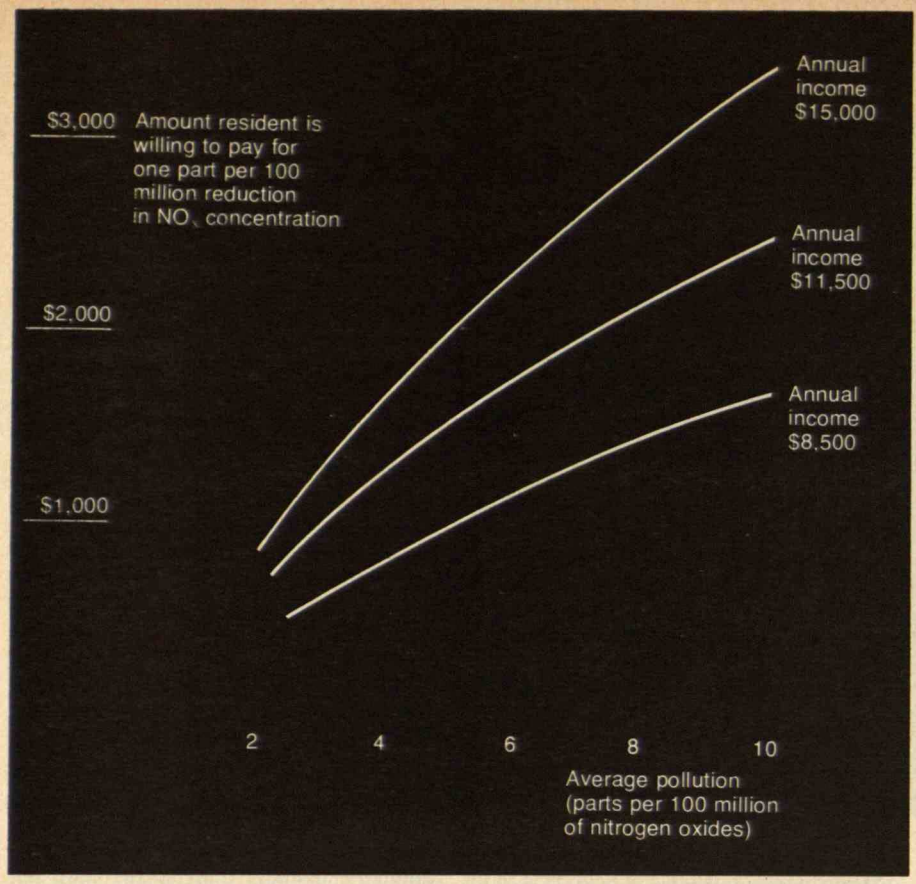
According to R.E.M., national electricity demand will increase 5 per cent a year between 1974 and 1985 and 4.6 per cent a year thereafter, until 1995. Electricity demand in New England will be higher than average — 5.96 per cent per year to 1985 — because fossil fuel prices are so high. For the same reason, New England's reliance on nuclear power will increase rapidly — to more than 90 per cent, according to the model taken literally, by 1995. (Professor Joskow and Mr. Rozanski think that's an overestimate, since nuclear plant load factors don't exceed 70 per cent; they propose that supply shortages might be made up by purchases from other regions.)

A hypothesized nuclear moratorium, eliminating new commitments of nuclear capacity after 1977, would have little effect on 1985 figures — those nuclear plants would be under construction before the moratorium. But the R.E.M.'s projections for 1995 would be changed — nuclear reduced by 50 per cent, coal consumption increased by 36 per cent, and electricity prices up by 6 per cent — an annual cost of $6 billion in 1975 dollars per year. The most substantial impact of such a moratorium would be on New England, where electricity prices would go up by 37 per cent by 1995. — *J.M.*

Distributing the Costs of Clean Air

Governments have at least two kinds of leverage for reducing air pollution. They may set standards with deadlines and exact legal or financial sanctions from offenders; or they may levy taxes (fees) — at fixed or sliding rates — on all emissions of polluters. Neither is ideal.

The principal frustration is technological: we still know far too little about measuring and controlling emissions and the effects of failing to do so.



Determining how much an American is willing to pay for cleaner air — a question generally not well understood — is crucial to the discussion of air pollution control strategies. The "most promising" approach, said Daniel L. Rubinfeld of the University of Michigan, comes from studies of comparative property values in areas of clean and dirty air. The chart, developed by Professor Rubinfeld from studies of Boston real estate markets, shows residents' apparent willingness to pay in relation to concentrations of nitrogen oxide pollutants.

Rigid, Insensitive, Unenforceable

The U.S. Congress has opted for standards and sanctions, probably because this format is consistent with most popular perceptions of the problem. A standard represents a collective, democratic decision about what is and is not acceptable, and the government's job is to reach and then enforce such judgments.

But standards are rigid: they are not necessarily achievable, insensitive to costs in relation to benefits, insensitive to relative efficiencies, and sometimes unenforceable.

For example, polluter A may be able to reduce emissions at less cost than polluter B; the socially economical way to reach a standard of 20 units may be for polluter A to reduce to 10 units, polluter B only to 30. Fixed, absolute standards do not give that option.

With the automobile, the enactment of absolute standards has in fact led to "slower and more costly emissions control than otherwise could have been achieved," said Edwin S. Mills of Princeton and Lawrence J. White of New York University. They spoke at an M.I.T. conference on "Air Pollution and Administrative Control" late last year. Their argument is that U.S. standards, which exceeded the capability of technology at the time of their enactment, forced automakers to seek "quick fixes" instead of focusing on research which might have yielded more innovative — and in the long run more satisfactory — solutions. Thus we are now driving cars with expensive catalytic converters while stratified-charge engines appear to be "a superior technology."

A Solution That Acts Like a Market

Economists, who think in terms of markets and prices, tend to favor fees or taxes. They interpret pollution as a failure of the market system to meet the full cost of making a product, and to advocate solutions which impose the cost of pollution on the products which cause it. For example, a power plant discharging SO_2 would have two alternatives:

— To reduce emissions by buying more expensive low-sulfur fuel or installing stack-gas cleaners; or

— To pay a fee based on the amount of the emissions.

In the ideal case the fee would be high enough to encourage clean-up.

Such a plan, say its advocates, has a built-in guarantee that optimum clean-up will be obtained at least cost. Each producer will work to reduce emissions until the cost for further improvement exceeds the fee to be paid; those who can most cheaply do so will clean up most.

In the case of the automobile, a system of effluent fees would have introduced "vital elements of competition and flexibility" into the clean-up program, said Professors Mills and White. There would have been strong incentive for the kind of long-range research that should have been done, stemming from the promise of marketplace rewards for building clean cars and durable emission control systems.

Matching Penalty and Social Cost

The missing element in fees is, of course, the sense of standard or goal, without which — according to critics — there is no absolute assurance of progress.

A middle ground — a combination of standards and taxes — thus has special appeal. At the conference, Michael Spence of Harvard and Martin Weitzman of M.I.T. argued for fixed emission standards with penalties for emissions in excess of the standards — the amount of the penalty to increase with the amount by which emissions exceed the standard. If the penalty is set correctly, they said, an individual polluter's payments will "closely approximate the social costs of his contribution to pollution." This is because the fees would be like the problem they attack: in most cases, damage caused by emissions increases at an increasing rate with the levels of pollution, just as the fees are supposed to do.

Marc Roberts, the Harvard expert on environmental economics, advocated a similar but more complex combination of standards and penalties, the penalties to be a function of the capital value of control devices necessary to meet the standards. The penalties would be waived when and if the appropriate capital investment were made, and thereafter the polluter would be subject to "a relatively tough scheme of fines based on the duration and magnitude of emissions violations."

The New Morality of Equity

When came the time for discussion, the standards-and-penalties advocates ran into a blizzard of criticism. Their plans thwart what Edwin Clark, II, of the Council on Environmental Quality thinks is today's new morality of equity: let the rich (say, the oil companies) pay more than the poor (say, the steel companies).

Dr. Clark also said he found the debate "over idealized," and cited the general lack of knowledge about pollution sources, about the costs associated with emissions control, and about measurement, inspection, and enforcement. "The last thing an administrator wants . . . is . . . a tax which he cannot administer and collect fairly," said Dr. Clark. Professor

Mills was similarly vexed, noting that — given our primitive capacity to measure pollutants and their effects — emissions can be related much more accurately to a fixed standard than to a sliding-scale fee.

And Professor Paul E. Samuelson of M.I.T. raised still a third problem: we lack, he said, any good model for relating pollution to "social utility" — a way to determine the real value which society should (and does) attach to the control of emissions. — *J.M.*

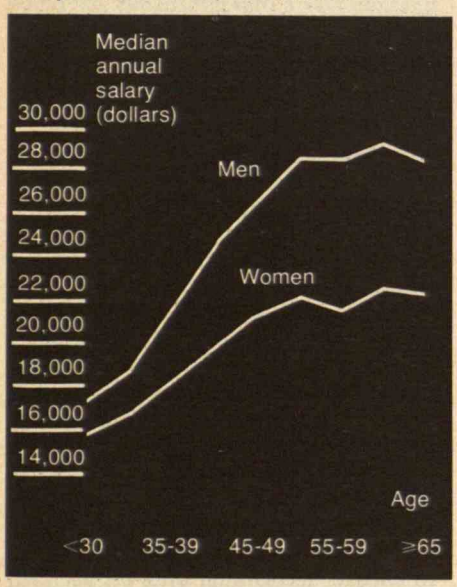
Discrimination in the Sciences

Some progress has been made, but the gains are small. Women with doctorate degrees in science and engineering still lag behind their male counterparts in salary and employment.

Comparing statistics from 1973 and 1975, the National Research Council found that unemployment of women scientists and engineers decreased from 3.9 per cent in 1973 to 3.0 per cent in 1975. The N.R.C. estimates that 26,300 women — about 9.4 per cent of the total doctoral population — are now in the work force. For the same two years, men saw unemployment rates of 0.9 and 0.8 per cent, respectively.

In 1975, the median salary for women scientists was $19,000. Men scientists averaged $4,500 higher for the same period. Women with doctorates in engineering fared slightly better, making an average of $21,000 per year, while male engineering Ph.D.s averaged $25,000.

The overall unemployment rate for engineers and scientists decreased from 1.2 per cent in 1973 to 1.0 per cent in 1975. — *S.J.N.*



In 1975, the median annual salary for men holding doctorates in science and engineering was greater than that for women at all ages measured. (Chart: National Research Council)

Technology as an Instrument of Power

International flow of technology can be an instrument for international progress and understanding, or "entrepreneurs" can be read "exploiters" throughout the Third World. To whom does technology really belong, and who is entitled to how much of its benefits?

The dialogue around this question will rise to a crescendo in 1979, when the United Nations convenes a Conference on Science and Technology for Development. Already the lines of argument are growing clear:

— Henry A. Kissinger, former Secretary of State, opening a Washington meeting early this winter designed to prepare his Department for its participation in the U.N.'s 1979 Conference, affirmed his confidence in the sources of innovation as we know them: "Ninety per cent of the transfer of all capital from private and public sources comes from the industrial democracies; there are no realistic alternative sources. . . . The process of development is not something that is handed by one group of nations to another group of nations."

— Science and technology have been molded by the advanced industrial nations to serve the needs of "high-level income groups with excessive consumption patterns," says Sumitro Djojohadikusumo, Indonesia's Minister of State for Research. Now, Mr. Djojohadikusumo told an international conference in Manila last fall, a "restructuring of institutional arrangements" involving "nothing less than the redistribution of decision-making . . . has become essential." In other words, technology, like the laws of nature to which it is obedient, is not the prerogative of the innovator. It is part of the "common heritage of mankind."

Export the Know-how

American industry's response to the Third World is a warning that technology alone — however made available — will not solve its problems. The history of the automobile, beginning with the invention of the internal combustion engine by Nikolaus Otto, demonstrates the crucial role of management in the success of new technology, said Henry Duncombe, Jr., Vice President and Chief Economist of General Motors Corp., at the State Department conference. Herbert Fusfeld, Director of Research at Kennecott Copper Corp., agreed: the less-developed countries' idea of separating technology from the machinery for its exploitation is naive, he said; those countries fail to recognize the necessity of capital and of expertness in its use.

Must management know-how always lead to enterprises in the image of American big business? Not at all, said Frank Pace, Jr., President of the International Executive Service Corps. He called attention to his own group's success in offering management skills appropriate to small business and low technology in Third World countries. Every less-developed country wants more technology than it is capable of managing, he said. "One of our greatest services has been to discourage such countries from seeking technology which is beyond their competence to use."

But Keep the Jobs

Cold water from labor: America has been exporting its technology for a century and more, and in the hands of foreign entrepreneurs — Japanese automakers and Brazilian aircraft builders, for examples — our technology has been turned against us, absorbing American capital, competing with American goods, and displacing American labor. If developing nations want our technology, let them pay for it, said William W. Winpisinger, General Vice President of the International Association of Machinists and Aerospace Workers.

To Professor Jay Weinstein, a sociologist at the University of Iowa, the assumption by all participants in the State Department conference that the flow of technology is necessarily from "us" to "them" seemed parochial and self-serving. Before 1979, he said, we should try to understand what are the real sources and incentives for new technology: Where and how does it really happen? What makes the difference between success and failure? What sorts of prerogatives can the contestants in this arena truly claim? — *J.M.*

Watch Technology

Every nation in the world has only three kinds of assets on which to build its prosperity and strength: people, geology, and climate. Of these, northwestern Europe is generously blessed with only two: intelligent, hard-working people (and the wealth of knowledge they've accumulated) and a temperate climate.

The missing ingredient is resources.

Europeans who understand this, says Karl F. J. Niebling, will concentrate their attention on technology, the key to making scarce resources go further. But Mr. Niebling — he is with Shell Petroleum International in Holland — thinks too many of his colleagues in management are having to think too much about the human side of the equation. They're neglecting "the subtle processes of change in the technological and natural sciences," he told a European management conference late last year — focusing too much on "the human sciences and the sociopolitical environment." — *J.M.*

Literate Computer: A Long Way to Go

Viewed from the perspective of a computer engineer, our ability to read is wholly miraculous. Even the first stage of the process — our ability to recognize characters and numbers in hundreds of typefaces and countless thousands of handwritten forms — is hardly less than a miracle. Despite decades of research with the largest machines, no computer yet built can approach it.

The following status report is based largely on papers on man-machine systems given last fall at the International Conference on Cybernetics and Society in Washington by Robert S. Apsey of I.B.M.'s System Communications Division; A. G. Kegel, J. K. Giles, and A. H. Ruder of the U.S. Postal Service's Research and Development Department; A. A. Spanjersberg of the Netherlands Postal and Telecommunications Services (P.T.T.); Joseph Yacyk of Scan-Data Corp.; and Louis R. Focht and Alfred Burger of Aeronutronic Ford Corp.

How to Read the Numbers We Write

If the task is to identify numbers from 0 to 9 placed in assigned places on a preprinted form, the problem is relatively simple and success almost within reach. The data on Maryland employers' withholding report forms — an average of eight hand-written digits with assigned places on the forms — are now read automatically. The previous reject rate — documents which the computer could not read or read incorrectly — of about 12 per cent is lower now, because employers' clerks are used to the forms and have been given special instructions.

When Maryland first tried to machine-process taxpayers' estimated-tax forms — only five digits, but entered by thousands of different taxpayers — the reject rate was 64 per cent; with familiarity and simple instructions that went down to 21 per cent, equivalent to a per-digit error rate averaging 3 per cent.

After two years of experience, West Virginia's Department of Motor Vehicles is successfully reading hand-printed social security numbers on 99 per cent of vehicle registration forms. A computer at Columbia House, the mail-order division of Columbia Records, correctly reads 63 per cent of the cards on which members have printed numbers of the selections they want to buy at a per-digit error rate of 4 per cent.

The Netherlands' Postal Giro Service — a commercial banking enterprise conducted by the Netherlands P.T.T. — now has 200,000 of its customers ordering their transactions on machine-readable cards. These are processed first by a scanner which translates the digits it reads into punched holes on the card, then by a verifier which reads the digits by a different system and compares them with the holes. Only 6 per cent of the digits are read incorrectly, for an overall error rate of 40 per cent; but the combination of reader and verifier catches all but 1 per cent of the errors, which is a lower error rate than achieved by human operators.

How Computers Try to Speed the Mail

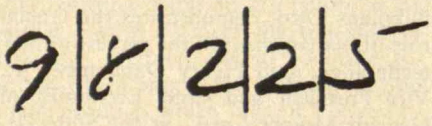
An obvious application of these techniques is automatic reading of zip codes on mail, the first step in automatic sorting. Here the problem of finding the five critical numbers in an address is superimposed on the problem of reading them.

The Japanese eliminate the "finding" problem by promoting envelopes with preprinted boxes to contain the postal codes; furthermore, mail users receive samples of numbers written as the computer prefers. Now the first three digits of these codes are read correctly on all but 10 per cent of the outgoing mail from Tokyo, Osaka, and several other cities, providing automatic sorting of 90 per cent of the mail to its correct destination city.

For more than four years the U.S. Post Office in Boston has automatically sorted mail with typewritten and printed zip codes. The OCR II Address Reader scans everything on the envelope looking for the patterns which characterize an address and from this correctly selects the zip code on 90 per cent of its input. Finding, reading, and sorting are done at the rate of 12 pieces per second.

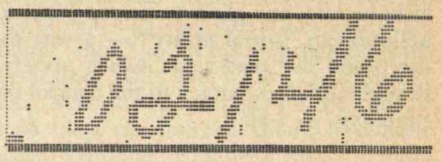
But handwritten addresses still confound the U.S.P.S. In addition to the problem of finding the five-digit zip code, which OCR II has solved, a machine to process handwritten addresses has to segment the digits into five individual problems and then deal with each of those problems in turn, by comparing what it sees with a host of possible models in its memory.

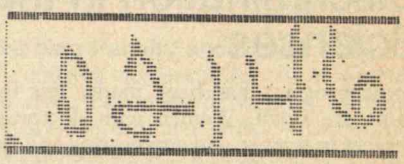
Segmenting is a problem because the numbers in handwritten zip codes often run together, the last stroke of a 2, 5, or 8



becoming the first stroke of the following number. Aeronutronic Ford's solution is a sub-routine that ignores strokes of a number when they "extend grossly beyond their normal bounds," and the result is that 89 per cent of handwritten zip codes can be properly segmented.

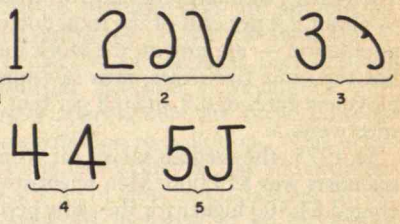
Then comes the toughest problem of all — identifying a number in its many different handwritten forms. Aeronutronic Ford's program begins with what is called "slant logic" — a program in the scanner





which normalizes slanted writing before it is presented to the recognition circuits.

Recognizing the many variations in handwriting is simply a matter of programming a large number of alternatives and asking the computer to look for them.



Messrs. Focht and Burger predict that the recognition rate for individual handwritten digits in the zip code reader which Aeronutronic is building for U.S.P.S. will be over 95 per cent, which means a success rate on five-digit numbers of over 77 per cent. Add to this the predicted 90 per cent success in locating the zip code and 89 per cent success in segmenting it, and the projected overall zip recognition rate is but 61 per cent.

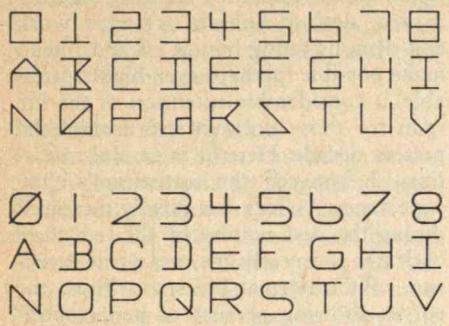
A Victory for People vs. Machines

If reading a hand-written "alphabet" of but ten characters — the numerals 0 through 9 — is so difficult, the 26-letter English alphabet, or the 52-character alphabet with upper and lower cases is a difficult problem indeed.

Some letters are harder than others. Barry A. Blesser and Robert Shillman, working in the M.I.T. Research Laboratory of Electronics under a National Science Foundation grant, have chosen to focus on the tough pairs first — seeking to program their computer, for example, to distinguish U from V and A from R. It's slow work — experiments relying on both psychology and engineering are required to uncover recognition rules for each letter. But the computer now reads Us and Vs better than humans (95 vs. 91 per cent). And their success gives Drs. Blesser and Shillman confidence: at the present rate, they think, a marketable computer

program that can read hand-lettered material (upper case only) may be possible in about five years.

This goal would be easier if handwriting were more disciplined. Mr. Aspey gave two idealized upper-case alphabets,



one square and one round, to groups of I.B.M. employees who were asked to duplicate one or the other, as well as they could, in all their computer-bound work. After three days of practice the subjects were all printing as well as they ever would, but most of them were frustrated. Those for whom hand printing was a primary job found the constraints completely unacceptable: those whose job required that they spend 30 or more per cent of their time printing to the required standards said it was simply too slow.

Another small victory for people over machines. — *J.M.*

Ladies and Gents, The Fairbanks String Quartet

Public television afficionados will notice definite improvements in the quality of their network service, as the Public Broadcasting Service (P.B.S.) becomes the first television network to distribute its programs by satellite in 1978.

By then, each public television station in the country, including Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands, will have sprouted a 30-foot antenna, aimed skyward to pick up signals from the two Westar satellites leased in order to relay programs. The satellites will replace 20,000 miles of microwave and cable facilities, and, according to John E. D. Ball of the P.B.S., will enable both higher quality and more flexible service to public television stations. At the National Telecommunications Conference in Dallas last winter he listed some specifics:

— It will be just as cheap to stage programs at stations far distant from the national origination center in Washington, D.C., as those close by. Now, origination costs increase greatly for stations in the western U.S.

— Technical quality of the television signal will be the same regardless of distance from the origination point. As it is now, the more distant the station, the poorer the signal.

— Programs will be distributed economically for the first time to non-mainland stations such as Alaska and Hawaii.

— Stations will be able to exchange programs without interrupting the entire network.

— Because the satellite will carry two television signals, stations near one another can receive different programs simultaneously without mutual interference.

— Finally, dual television signals will enable two programs to be sent to the same station at the same time. — *D.M.*

SPACE

Spritz in Space

It'll be a tricky business for the Space Shuttle — retrieving a spinning satellite or rescuing crewmen from a wildly gyrating spacecraft.

Two Pennsylvania State University scientists may have hit upon an exquisitely simple method to stop objects spinning in space — a blast of water.

Aerospace engineers M. H. Kaplan and D. C. Freeland have conducted tests with liquid jets exhausting into a vacuum, and have found that the liquid tends to accumulate on the target as ice, absorbing the object's spinning momentum. The ice then sublimes in a vacuum, carrying away with it the angular momentum.

Drs. Kaplan and Freeland accidentally discovered the technique when performing tests to see if the force of water from a jet could be used to stop spinning objects. During the experiments in their laboratory vacuum chamber, they discovered that ice tended to form on the object, and upon running tests with gentler water sprays they discovered that the ice formation and sublimation was an excellent momentum-disperser.

Their preliminary calculations indicate that "despinning" an object as large as a Space Shuttle Orbiter would require far more water than a rescue Orbiter could carry. But, the amount of water required to stabilize smaller vehicles and satellites would be well within the Shuttle's cargo-carrying ability. These calculations are only tentative, however, since the scientists assumed that only about 30 per cent of the water sprayed would adhere to the object's surface. Drs. Kaplan and Freeland plan to propose that N.A.S.A. conduct tests in orbit to determine the accuracy of their assumption.

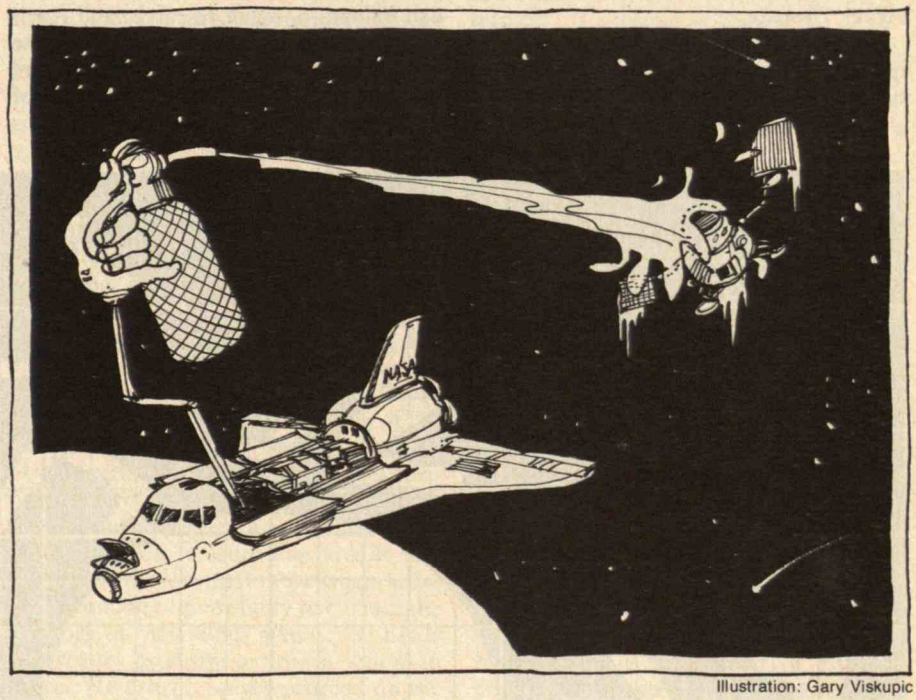


Illustration: Gary Viskupic

Their calculations also indicate that the ice formation-sublimation process might slow a spinning object to a standstill within about two hours, so Shuttle crews would not have to spend long periods in orbit waiting for their quarry to stop spinning. Their analysis of the orbits of satellites currently in space and of Shuttle Orbiter payload capabilities indicate that most satellites could be reached by an Orbiter carrying a load of water, and their spins halted.

The technique is simple, say the scientists, requiring little hardware or technique. All the crew must do is aim a nozzle and let fly. If their technique proves successful, perhaps astronauts of the future will spend part of their training time consulting with visiting firemen. — *D.M.*

Books and Comments

Continued from p. 15

Tomorrow and tomorrow and tomorrow. . .

Prolongevity
Albert Rosenfeld
New York: Alfred A. Knopf, 1976, xix + 250 + xii pp.; $8.95

Reviewed by Robert S. Morison

Perhaps I should begin by warning that I am more than a little uneasy about the principal thesis expressed by the title of this book. The majestic natural law handed down to us from Aristotle and Cicero, with some modification by Saint Thomas Aquinas, now formally survives in only two — rather different — activities: the prohibitions of the Catholic bishops on sexual behavior and the justification of anarchy and revolution by dissident students and other disciples of Henry Thoreau.

Clandestinely, however, remnants of natural law survive in the emotional reactions of biologists whose minds know all about the dangers of the "naturalistic fallacy" and David Hume's warning against confusing "is" and "ought," but whose hearts quail at the thought of men taking over the direction of affairs that nature has managed so well for so long. Old-fashioned biologists worry about endangered species and other intrusions into the classical order of nature. New-fashioned ones worry about analagous intrusions at the cellular or molecular level. And each man has a different price or sticking place. Almost all biologists, of course, practice artificial birth control, and most would resort to artificial insemination if the occasion should arise. But some begin to feel squeamish about artificial ovulation and test tube fertilization, while many have already squirmed at the possible use of the technique to clone genetically similar individuals.

Planned Obsolescence

Currently the most distinguished of the reluctant dragons is Professor Robert Sinsheimer, Chairman of the Biology Division of the California Institute of Technology. He is particularly concerned about transgressing the taboo nature appears to have erected against mixing prokaryotic (bacterial) with eukaryotic (higher plant and animal) nucleic acid. But he worries almost equally about sex determination, aging research, and (curiously enough) efforts to communicate with beings from other worlds. Although I find that his objections to the mixing of DNA verge on the mystical, I share his intuitive concern about tampering with our finite life span. Thus, as I noted earlier, I am prejudiced against the central thesis of the book under review.

Nevertheless, one can only be grateful to Alfred Rosenfeld for bringing together a great deal of hitherto scattered work and demonstrating how it all adds up to make possible (perhaps even highly probable) a considerable extension of the life span for those born in and around the present decade. Here he is careful to distinguish between the statistician's "life expectancy," which has greatly increased during the past century by the reduction of deaths at an early age, and a true extension of the normal life span. Thus, the curves showing percent of people born who were still alive at various ages in 1770, 1870, and 1970 respectively are very different from one another during the early years of life and become more and more alike after the psalmist's three score and ten, flattening out together to very nearly zero at 100. Extending the life span would move the whole curve out to the right, with the steepest part no longer in the 70s and early 80s, but perhaps in the 90s or early 100s, with a respectable tail running out into the 140s, 150s. Indeed, there are times when Mr. Rosenfeld seems to hope that the curve will never go down to zero at all. In support of his hopes, Mr. Rosenfeld marshals a lot of evidence from cellular and molecular biology, and the study of higher level control mechanisms

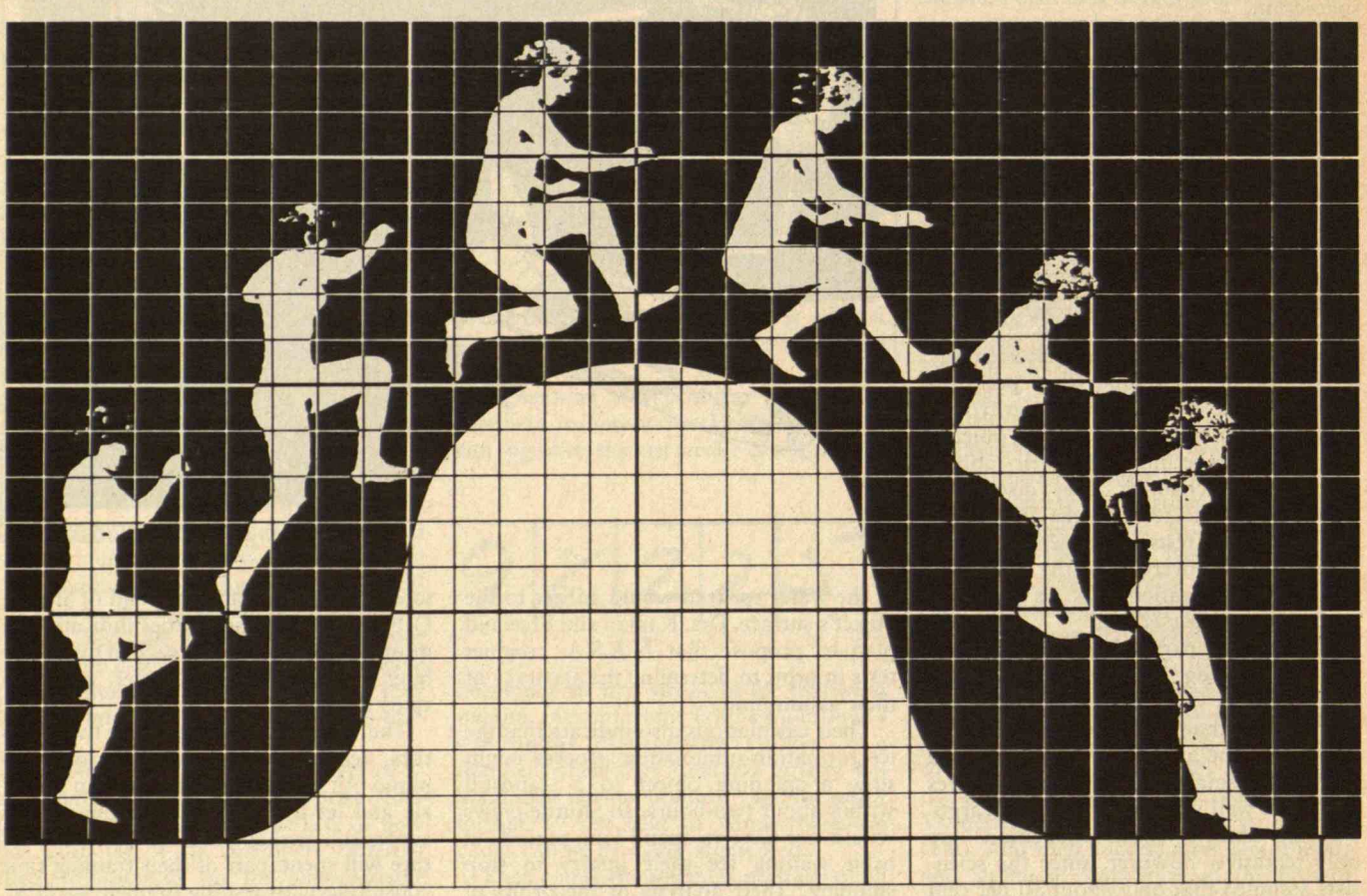


Illustration by Judy Richland

showing that the finiteness of life is not simply due to wear and tear, but results from an actual design — what critics of the automobile industry might refer to as planned obsolescence. Not only do the experimental facts support this hypothesis; the theory of evolution suggests the need to eliminate old models in order to make room for new and presumably better ones.

Charlatans and Mystics

To the prolongevitists, knowledge of the design plan immediately suggests the possibility of modification and control. Indeed, it is the belief that we are getting close to such control that prompted Mr. Rosenfeld to write the book at this time. The text makes clear that he enjoys life and has long been eager for some kind of earthly immortality. In the closing chapters he cites others who in the past have shared the same longings and dismissed them as impossible to realize. It is to dispel this inhibition and open the world of immortality to more definitive speculation that he now gives us this book.

There can be little doubt that the author is one of the more talented and industrious of our currently small cadre of competent scientific journalists. He is clearly capable of understanding the subtleties of biological studies and he has a gift (necessary, I think, in a popularizer of science) for making everything just a little bit clearer than it really is. Probably all good science writers are frustrated scientists. Some like Jack Geiger and Lester Grant actually become practicing scientists. Others, like Mr. Rosenfeld, make their scientific contribution by putting a lot of ideas together to present a visible functioning whole that no true scientist would feel quite secure about. Just this willingness to synthesize so as to stimulate the analysis of alternative futures will doubtless become more necessary if "technology assessment" is ever to become more than a controversial congressional office.

Among other things, Mr. Rosenfeld has had to struggle with the fact that the field of gerontology has always attracted more than its share of charlatans, enthusiasts, self-deceivers, and mystics. The Vatican physicians (or wizards) who tried to rejuvenate Innocent VIII by transfusing him with the blood of several young children (all of whom were said to have died) have had far too many successors willing to transplant testicles or inject indescribable concoctions of cells into the wealthy aged.

Even today, gerontology has more than its share of unusual personalities. One of its most durable and influential practitioners took time out recently to write two fancily and fancifully illustrated books on the joy of sex. Just before going to press, Mr. Rosenfeld was forced to add an embarrassing footnote to an elaborate multi-page explanation of one of the most exciting theories of cellular aging. Although the note gives only the faintest hint, it seems that the author of this theory has had to resign his Stanford professorship as the result of a hassle involving, among other things, some obscure dealings with a commercial house and unexplained mislabelling of some important tissue cultures. There are many other similarly garish twists in the fringe that has always surrounded the serious study of aging. Fortunately, despite his obvious enthusiasm, the author appears to know where most of the bodies are buried. And even if his textual citations are weighted on the side of the living, he provides an unobtrusive but helpful bibliography for those who want to do some post mortem examinations of their own.

Endless Pleasure

In summary then, he convinces a reviewer who doesn't particularly want to believe it, that some effective tampering with the aging mechanism is likely to be undertaken quite soon. Indeed, Mr. Rosenfeld himself, along with a number of partially convinced scientists, ingests daily amounts of vitamin E in hopes of reducing the aging effects of free radical oxidation of important cellular constituents.

The last third of the book that deals with the pros and cons of extending the life span is frankly disappointing. It begins with a brief, rather superficial, sometimes almost flippant look at the literature of man's yearning for immortality and notes the dangers of failing to specify the kind of life to be extended, as typified by the myth of Tithonus. In his even briefer treatment of the biological, social, and psychological consequences of living forever, Mr. Rosenfeld reminds one of nothing so much as some latter day Condorcet come to tell us how the dreams of reason put perfectability just around the corner and a spring chicken in every pot. In all events, his understanding of the philosophical, sociological, and psychological aspects of aging seems more sketchy and episodic than his grasp of the biological issues, based on his command of the literature and warm personal relations with many of the leading figures.

Nevertheless, even an uncritical embrace of endless pleasure may have its uses if it warns those with a more tragic sense of the coming responsibility to balance the longings of individuals against the needs of a society extensive in time as well as in space. We can no longer proceed on the comfortable assumption that old generals (or anyone else) will simply fade away. It is reflections such as this that make one lend at least one ear to that still small group of biologists who fear that free inquiry can lead to an excess of knowledge.

Robert S. Morison is Class of 1949 Visiting Professor of Humanities at M.I.T. From 1964 to 1970 he was Director of the Division of Biological Sciences; from 1970 to 1975, Richard J. Schwartz Professor of Science and Society at Cornell University.

Letters

Continued from p. 3

debate. PCRG does not intend to let that happen. If Cyclops would be of value for purely scientific reasons, independent of the extra-terrestrial issue, then perhaps it should be supported. But the creators of the project have not made that clear to the public.

5. Mr. Gardner writes (*p. 46*): ". . . the concept [of superluminal information transfer] is simple, but the paraphysicist makes it sound scientific by hoking it up with technical jargon. The 'measure of information', according to Sarfatti, is 'the degree of order in the energy already existing at a particular place. . . .' "

This is more than hoking with technical jargon. For example, David Hawkins writes: ". . . the physical concept of work, as distinguished from energy, has itself an informational aspect. The performance of 'useful work' . . . is to produce a situation having a certain order or information. It is to inform a physical system in some way, to transfer order or information to it. To say that free energy is energy available for external work is to say that order cannot come into existence *ex nihilo,* but only by transfer" (*Language of Nature,* p. 216).

Since Lord Kelvin in the 19th century, the notion of order as the thermodynamic quality of energy has been well established. The new idea that I present is of a nonlocal, superluminal (i.e., space-like) transfer of the quality of energy, not the amount of energy. I suggest that the essence of quantum theory is the *nondynamical* transfer of order (i.e., quality of energy) without the dynamical transfer of energy through space. As Schrodinger wrote of the Einstein-Rosen-Podolsky effect: "It is rather discomforting that [quantum] theory should allow a system to be steered or piloted into one or another type of state at the experimenter's mercy in spite of his having no access to it" (*Proceedings of the Cambridge Philosophical Society,* 31, 555 [1935]).

6. Werner Erhard's support of PCRG does not imply that Mr. Erhard or est (Erhard Seminars Training) fully endorse every action and policy of PCRG, or vice versa. PCRG is not a part of est. Mr. Erhard and I share a warm personal relationship that enriches both our lives independent of ideological and scientific beliefs.

Jack Sarfatti
San Francisco, Calif.

Dr. Sarfatti is founder of the Physical Consciousness Research Group. — Ed.

How to Break a Rock to Make a Balance

Puzzle Corner
by
Allan J. Gottlieb

This month we are presenting answers to seven problems. In addition to the five December puzzles, we have (the revised) **J/A1** and **PERM 2.** Thus the solution section of this column is long, and I will limit my introductory remarks to noting that Dr. Leo Epstein has been working on an outgrowth of **1974 M/A 2,** finding a closed form for

$$S(n) = \sum_{x=1}^{n} x^x.$$

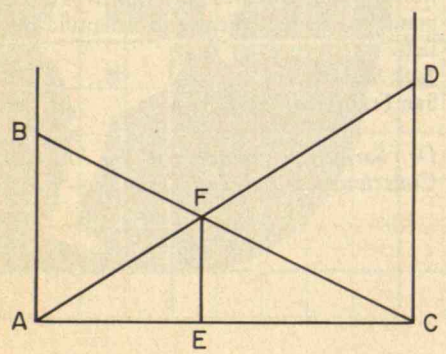
Anyone wishing details should write to him at Argonne National Laboratory, 9700 South Cass Ave., Argonne, Ill., 60439.

Problems

M/A1 We begin this month with a bridge problem from William J. Butler, Jr.: Rodney Yarborough, world's unluckiest bridge player, has been playing bridge for a number of years. During this period he has never received a hand worth even a single point. (Conventional point counting gives four points for each ace, three per king, two per queen, and one per jack. Also, void suits count three, singleton suits two, and doubleton suits one.) Rodney calculates that he has seen more than 1 per cent of the total number of these terrible hands. What is the minimum number of hands that Rodney has seen?

M/A2 Our next problem, related to **1975 M/A 3,** is from William Fitch Cheney and Norman M. Wickstrand:

Given AB, CD, and EF perpendicular to AC, find any set of integers x, y, m, w, and h such that $x = \overline{CD}$, $y = \overline{AB}$, $m = \overline{AD}$, $n = \overline{BC}$, $w = \overline{AC}$, and $h = \overline{ET}$.



M/A3 A friendly number-theory problem from Chip Lawrence:

A rural storekeeper in Georgia has a set of balance scales and a rock weighing 40 pounds. A seller from the city is passing through and he luckly has a set of conventional scales. Seizing upon this opportunity, the storekeeper desires to break his rock up so that he can weigh any exact poundage between one and 40 pounds. The city seller, however, plans to charge outrageous rates for the use of his modern scales. What is the minimum number of pieces into which the storekeeper can break his rock and still accomplish his purpose? How much would each weigh? (Rocks may be placed on either or both trays of the balance scales.)

M/A 4 Jack Parsons wants you to find the fourth term for each of the following (related) sequences:

(a) 1, 20, 190
(b) 1, 21, 210
(c) 1, 22, 231

M/A 5 We end with an interesting geometry problem from Richard Brady: Prove that the sum of the distance from any point in or on an equilateral triangle to the three sides of the triangle is constant.

Speed Department

M/A SD1 Continuing in his effort to ease our conversion to metric, R. Robinson Rowe offers the following:

The very up-to-date weathercaster on a local TV station reports both Fahrenheit and Celsius temperatures. Recently, for a nearby city, his two figures for the low temperature that morning were in the ratio of 5 to 1, and, by a coincidence, so were his figures for the high temperature that afternoon. Quick, what was the daily range?

M/A SD 2 An interesting paradox from Sam Gutmann:

Jack Suburb went to the bank to get a mortgage on a new house which cost $20,000; Jack wanted to pay in 30 yearly installments, at 8 per cent interest. Let x be the yearly payment. Then the total he pays is 30x. The total he owes is $20,000 plus interest. The interest for the first year is (.08) (30x), for the next year (.08) (29x), for the next (.08) (28x), etc., since in each case those are the amounts he still owes the bank. So, $30x = 20{,}000 + (.08)(30x) + (.08)(29x) + \ldots (.08)(x)$. Solving, $x < 0$. Does the bank owe Jack money??

Solutions

PERM 2 Construct as many integers as possible using four 4s; for example, $14 = \sqrt{4} + 4 + 4 + 4$. The greatest integer function is not allowed.

As usual with this type of problem, it is not clear what is legal. As originally stated, the greatest integer function is out. I am also eliminating transcendental functions (T, antilog, etc.) except for $\sqrt{\ }$ ($\sqrt[3]{\ }$, etc., are out). Factorials are OK, but combinations and permutations are not. Finally, .4 = .44444 . . . is also illegal. I realize that these rules are arbitrary, especially the ones concerning $\sqrt{\ }$ and !. I have pooled everyone's results and here is the list up to 100. The solutions for 1 to 30 appeared in July/August, 1976, as the solution to **1976 M/A5.** Numbers over 100 will appear in subsequent issues, so there is still time to contribute. How about 73? Impossible?

31. $(4 + 4!)/4 + 4!$
32. $4^4/(4 \times 4)$
33. $(\sqrt{4}/.4) + 4! + 4$
34. $(4! \times .4) + .4 + 4!$
35. $4! + 44/4$
36. $4! + 4 + 4 + 4$
37. $[(4! + .4)/.4] - 4!$
38. $(4/.4) + 4! + 4$
39. $44 - (\sqrt{4}/.4)$
40. $4! + 4! - 4 - 4$
41. $[(\sqrt{4} + 4!)/.4] - 4!$
42. $4! + 4! - (4!/4)$
43. $44 - 4/4$
44. $44 + 4 - 4$
45. $44 + 4/4$
46. $44 + 4 - \sqrt{4}$
47. $4! + 4! - 4/4$
48. $4! + 4! + 4 - 4$
49. $4! + 4! + 4/4$
50. $44 + (4!/4)$
51. $[(4! - \sqrt{4})/.4] - 4$
52. $(4! \times 4) - 44$
53. $4! + 4! + (\sqrt{4}/.4)$
54. $(4!/.4) - (4!/4)$
55. $(44/\sqrt{4})/.4$
56. $4! + 4! + 4 + 4$
57. $[(4! - \sqrt{4})/.4] + \sqrt{4}$
58. $(4! + 4!) + 4/.4$
59. $(4!/.4) - 4/4$
60. $44 + (4 \times 4)$
61. $(4!/.4) + 4/4$
62. $(4!/.4) + 4 - \sqrt{4}$
63. $(4^4 - 4)/4$
64. $4! + 44 - 4$
65. $(4^4 + 4)/4$
66. $(4!/.4) + (4!/4)$
67. $[(\sqrt{4} + 4!)/.4] + \sqrt{4}$
68. $4^4/4 + 4$
69. $[\sqrt{4} + 4!)/.4] + 4$
70. $(4!/.4) + (4/.4)$
71. $(4! + 4.4)/.4$
72. $44 + 4 + 4!$
73.
74. $(4! + 4!) + (4! + \sqrt{4})$
75. $(4! + 4 + \sqrt{4})/.4$
76. $(4!/.4) + (4 \times 4)$
77.
78. $4(4! - 4) - \sqrt{4}$
79. $[(4! - \sqrt{4})/.4] + 4!$
80. $(44 - 4!) \times 4$
81. $(\sqrt{4} + 4/4)^4$
82. $4(4! - 4) + \sqrt{4}$
83. $[(4! - .4)/.4] + 4!$
84. $4 \times (4! - 4) + 4$
85. $[(4! + .4)/.4] + 4!$
86. $(4 \times 4!) - (4/.4)$
87.
88. $44 + 44$
89. $[(\sqrt{4} + 4!)/.4] + 4!$
90. $(4 \times 4!) - (4!/4)$
91. $(4 \times 4!) - (\sqrt{4}/.4)$
92. $4! + 4! + 44$
93.
94. $(4 \times 4!) - (4/\sqrt{4})$
95. $(4 \times 4!) - 4/4$
96. $(4 \times 4 \times 4!)/4$
97. $(4 \times 4!) + 4/4$
98. $(4 \times 4!) + (4/\sqrt{4})$
99.
100. $4 \times (4! + 4/4)$

Solutions came from Harry Zaremba,

Sam Jacobs, William J. Butler, Jr., Thomas Jenkins, S. D. Turner (or $\int dt$), Morrie Vasser, George H. Ropes, and Robert Roth.

1976 J/A 1 What is the minimum number of pieces required for a position in which

A. If White is to move,

1. The situation is a stalemate;
2. White must win;
3. Black must win. Or

B. If Black is to move,

1. The situation is a stalemate;
2. White must win;
3. Black must win.

The three requirements when White is to move combine with the requirements when Black is to move to create nine sub-problems. Three comments are in order: pieces include pawns; the sub-problem A = 2, B = 3, for example, requires that when White moves first he wins for any sequence of legal moves, and similarly for Black; and (as clarified in December) you may *not* assume logical play (so, for the sub-problem A = 2, B = 3, for example, you must find a position satisfying: 1) If White moves first, *any* sequence of legal moves leads to a White victory (this is A = 2); and 2) If Black moves first, *any* sequence of legal moves leads to a black victory (this is B = 3). Similar remarks hold for the other eight cases.)

I offer the conglomeration of solutions shown at the right, above, sent by Harry Nelson, Steve Grant, and the proposer, Bill Saidell. (A3 — B2 is from Mr. Nelson — what a thought!) Responses were also received from Eric Jamin, Anthony Coppola, William J. Butler, Jr., and Joseph A. Haubrich.

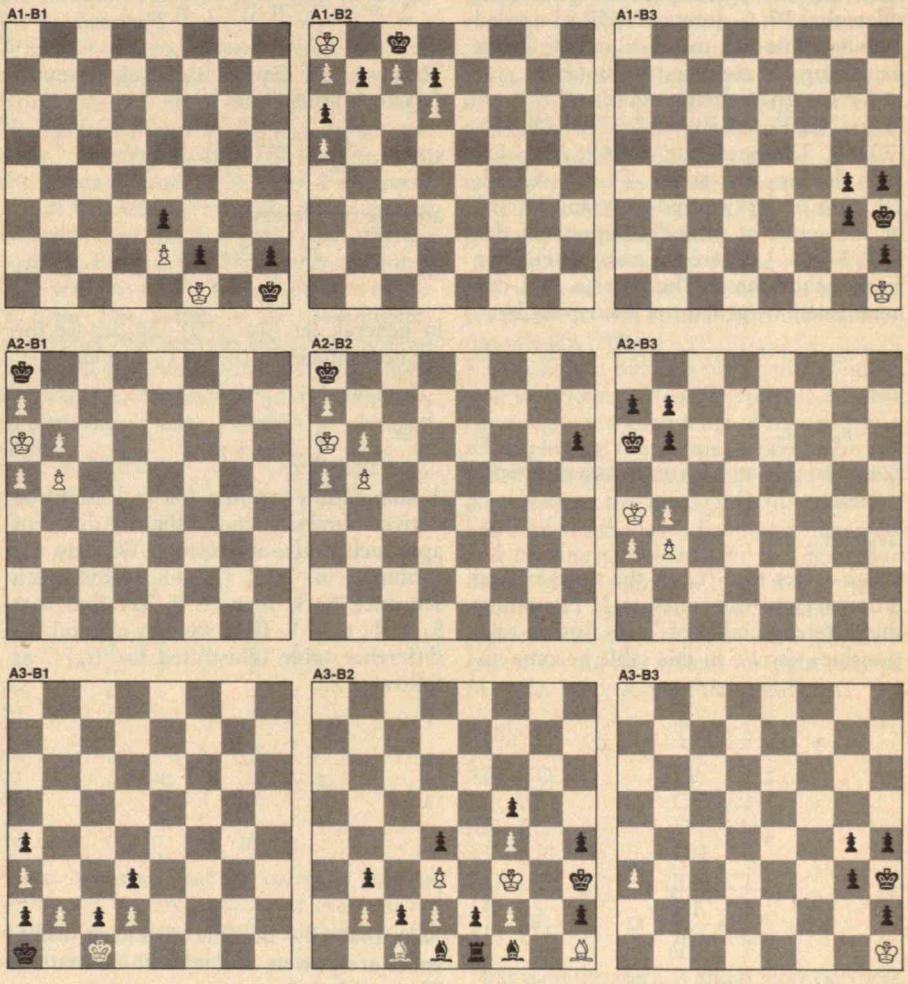
DEC 1 How should eight queens be placed on the chess board so that the total number of moves is maximum?

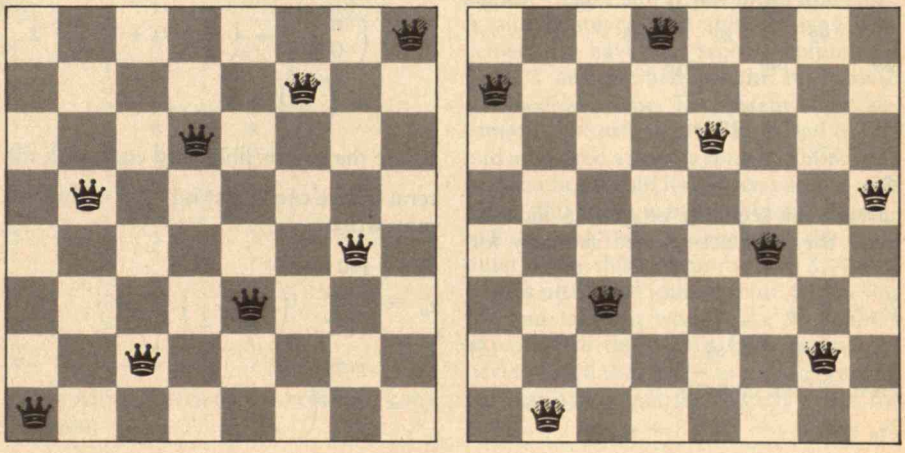
Only William J. Butler and R. Robinson Rowe responded to the challenge. I'm quite sure that Frank Rubin, the proposer, will let us know if the solutions are non-optimal; he implied that they are (chess diagrams at right, bottom).

DEC 2 An interesting series is the "paired" series:

(1,1), (2,3), (5,7), (12,17), (29,41), (70,99), . . .

a. What is the next pair?





b. What is the "rule" for constructing the series?

c. Show that the pairs give solutions to the equation:

$$2n_1^2 \pm 1 = n_2^2$$

and that the plus and minus signs alternate. The limit is, of course, $\sqrt{2}$ for the ratio of the pairs.

In his first contribution to Puzzle Corner, Douglas Szper has given us an extremely thorough presentation. Not content with recursion formulas, he derives closed forms using one of the cornerstones of numerical analysis, Newton's Forward Difference Formula. Finally a generalization is given. The advantage of a closed form can be appreciated when one considers that W. C. Johnson's HP 55 needed over ten minutes to calculate the 261st pair using the recursion formulas.

We are given the paired series: (1,1), (2,3), (5,7), (12,17), (29,41), (70,99). The next pair is (169, 239). Let $\{s_i\}$ denote the series {1, 2, 5, 12, 29 . . .} of first components and let $\{t_i\}$ be the series of second components, {1, 3, 7, 17, . . .}. There are many interesting relationships here. The pair (s_n, t_n) can most easily be generated recursively by:

$$s_n = s_{n-1} + t_{n-1}, (s_1, t_1) = (1, 1) \quad (1)$$

and

$$t_n = s_n + s_{n-1} \quad (2)$$

Equation (1) can be written as a difference formula:

$$\Delta s_n = t_n, \quad (3)$$

which states that $\{t_n\}$ is the series of first differences of the series $\{s_n\}$. Examining the difference table of $\{s_n\}$, further relationships shown in this table become ap-

s	Δ	Δ²	Δ³	Δ⁴	Δ⁵	Δ⁶	Δ⁷
1							
	1						
2		2					
	3		2				
5		4		4			
	7		6		4		
12		10		8		8	
	17		14		12		8
29		24		20		16	
	41		34		28		24
70		58		48		40	
	99		82		68		
169		140		116			
	239		198				
408		338					
	577						
985							

parent. The sequence of $\Delta^2 s_n$ is equal to twice the sequence s_n, and similarly for t_n:

$$2s_n = \Delta^2 s_n \quad (4)$$

$$2t_n = \Delta^2 t_n = \Delta^3 s_n \quad (5)$$

From (4) we obtain:

$$2s_n = s_{n+2} - 2s_{n+1} + s_n, \text{ or}$$

$$s_{n+2} = 2s_{n+1} + s_n, s_1 = 1, s_2 = 2 \quad (6)$$

This is a recursive formula for $\{s_n\}$, and we have a parallel formula for $\{t_n\}$:

$$t_{n+2} = 2t_{n+1} + t_n, t_1 = 1, t_2 = 3 \quad (7)$$

To develop a "rule" for $\{s_n\}$, we examine the forward differences and note that they are the powers of 2, each appearing twice. Using Newton's Forward Difference Formula, we have:

$$\begin{aligned} s_n &= s_1 + [(n-1)/1!]\,\Delta s_1 \\ &\quad + [(n-1)(n-2)/2!]\,\Delta^2 s_1 \\ &\quad + [(n-1)(n-2)(n-3)/3!]\,\Delta^3 s_1 \\ &\quad + \ldots \\ &= ([1 + (n-1)]/1!)2^0 \\ &\quad + ([3 + (n-3)]/3!)2^1(n-1) \\ &\quad (n-2) + \ldots \\ &= \binom{n}{1} 2^0 + \binom{n}{3} 2^1 + \binom{n}{5} 2^2 + \ldots \end{aligned}$$

Thus we can express the even terms of $\{s_n\}$ by a finite sum:

$$s_{2m} = \sum_{i=1}^{m} \binom{2m}{2i-1} 2^{i-1} \quad (8)$$

and the odd terms by

$$s_{2m-1} = \sum_{i-1}^{m} \binom{2m-1}{2i-1} 2^{i-1} \quad (9)$$

In general, let $[\![(n+1)/2]\!]$ denote the greatest integer in $(n+1)/2$; then:

$$s_n = \sum_{i=1}^{[\![(n+1)/2]\!]} \binom{n}{2i-1} 2^{i-1} \quad (10)$$

A summation formula for $\{t_n\}$ could be derived similarly, but a slightly different approach is also interesting. We may use formulas (6) and (7) to extend each sequence back to n = 0. We find that $S_0 = 0$, $t_0 = 1$. Thus we may expand the difference table (illustrated for $\{t_n\}$) as follows:

1							
	0						
1		2					
	2		0				
3		2		4			
	4		4				
7		6					
	10						
17							

Note that now the 0th advancing differences are powers of 2 and 0, alternating. Thus we have:

$$\begin{aligned} t_n &= \binom{n}{0} 1 + \binom{n}{1} 0 + \binom{n}{2} 2 \\ &\quad + \binom{n}{3} 0 + \ldots, \end{aligned}$$

where the sum is finite and ends with the term whose coefficient is $\binom{n}{n}$. Thus we may write

$$\begin{aligned} t_n &= \sum_{i=1}^{[\![n/2+1]\!]} \binom{n}{2i-2} 2^{i-1} \\ &= \sum_{i=1}^{[[n/2]]} \binom{n}{2i} 2^i \quad (11) \end{aligned}$$

Using the first recursion relation in equations (1) and 2), if the one pair of the sequence (x,y) satisfies

$$2x^2 - 1 = y^2$$

then the next pair is (x + y, 2x + y) and we have:

$$\begin{aligned} 2(x+y)^2 + 1 &= 2x^2 + 4xy + 2y^2 + 1 \\ &= 2x^2 + 4xy + (2x^2 - 1) \\ &\quad + y^2 + 1 \\ &= 4x^2 + 4xy + y^2 \\ &= (2x + y)^2 \end{aligned}$$

Thus, if any pair satisfies $2s^2 - 1 = t^2$, the next pair satisfies $2s^2 + 1 = t^2$. Likewise, if a pair (x,y) satisfies $2s^2 + 1 = t^2$, then:

$$\begin{aligned} 2(x+y)^2 - 1 &= 2x^2 + 4xy + 2y^2 - 1 \\ &= 2x^2 + 4xy + (2x^2 + 1) \\ &\quad + y^2 - 1 \\ &= 4x^2 + 4xy + y^2 \\ &= (2x + y)^2, \end{aligned}$$

so the next pair satisfies $2s^2 - 1 = t^2$. Therefore, since $2(1^2) - 1 = 1$, the pair (1,1) satisfies the equation

$$2s^2 \pm 1 = t^2 \quad (12)$$

with the "−" sign, and each pair of the sequence satisfies (12) with alternating signs.

Also solved by Harry Zantopulos, Barry R. Davis, Avi Ornstein, R. Robinson Rowe, Frank Carbin, Doug Hoylman, Emmet J. Duffey, William J. Butler, Jr., Jim Ertner, John F. Chandler, Bruce Fleischer, John E. Prussing, Mary Lindenberg, Row Moore, Harry Zaremba, Stephen F. Wilder, and the proposer, Winslow H. Hartford.

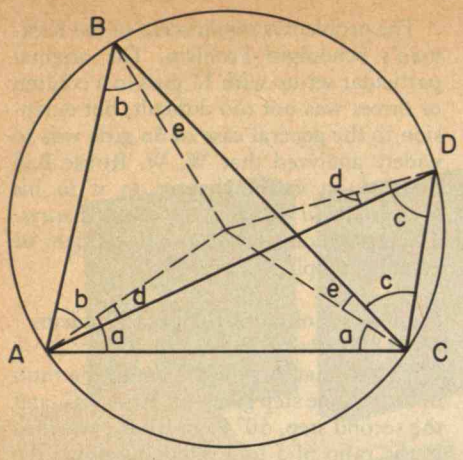
DEC 3 The horopter is the set of points in space which, in traveling from one to another, subtend equal retinal angles. The horopter in a horizontal plane is a circle which passes through the centers of the lenses. In order to show this the necessary theorem was: Given a circle with a chord drawn, the vertical angle of any triangle constructed on that chord will be equal. Phrased that way, of course, it is not true — but if the constraint that the triangles be on the same side of the chord is invoked, then it is true. The problem: prove that given the circle shown, angle ADB = angle ACB.

Many solutions reduced this problem to the theorem that an angle in a circle measures half its inscribed arc. I suspect that the best proof came from an old geometer, but it was all Greek to me. The following solution from Harry Zentopulos solves the original problem directly:

With respect to triangle ABC (*drawing, next page*), angle A plus angle B plus angle angle B plus angle C = 180°. Therefore,

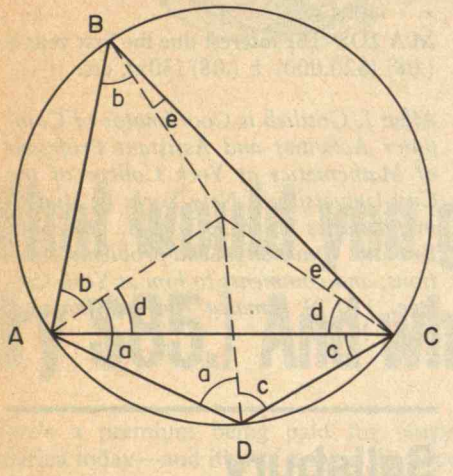
$$\begin{aligned} (a+b) + (b+e) + (a+e) &= 180° \\ 2(a+b+e) &= 180° \\ a+b+e &= 90° \\ b+e &= 90° - a. \quad (1) \end{aligned}$$

With respect to triangle ADC, angle A plus angle D plus angle C = 180°. Therefore,



$$(a - d) + (c - d) + (a + c) = 180°$$
$$2(a + c - d) = 180°$$
$$a + c - d = 90°$$
$$c - d = 90° - a. \quad (2)$$

Combining (1) and (2),
$b + e = c - d$, and angle B equals angle D.



With respect to triangle ABC above, angle A plus angle B plus angle C = 180°. Therefore,

$$(b + d) + (b + e) + (d + e) = 180°$$
$$2(b + d + e) = 180°$$
$$b + d + e = 90°$$
$$b + e = 90° - d.$$

With respect to triangle ADC, angle A plus angle D plus angle C = 180°. Therefore,

$$(a - d) + (a + c) + (c - d) = 180°$$
$$2(a + c - d) = 180°$$
$$a + c - d = 90°$$
$$a + c = 90° + d.$$

Therefore, $(b + e) + (a + c) = 180°$ and angle B plus angle D = 180°.

Also solved by R. Robinson Rowe, Emmet J. Duffy, William J. Butler, Jr., John E. Prussing, Mary Lindenberg, Harry Zaremba, Benjamin Gray, Clem Wang, Joe Lacey, John F. Chandler, Row Moore, Barry Davis, Robert Pogoff, and the proposer, Joe Horton.

DEC 4 For any positive integer n, there are 2^n distinct binary numbers of n binary digits (bits), leading zeros allowed. Here is the list for n = 2, arranged in counting order:

00
01
10
11

In decimal, they would read 0, 1, 2 and 3. In order to solve some problems in digital design, the list should be arranged so only *one* bit changes from line to line, including the wrap-around case (bottom line back up to top line).

Here's one solution for n = 2:

00
01
11
10

Problem: find a method for generating such a sequence for arbitrary n.

Basically there are two ways of wording the solution. Robert Pogoff tells us which bit to change:

With the sequence listed, there are n columns and 2^n rows, for all the changes. Row 1 is the start; row 2 is the first change in column 1. Then: Change column 1 in every second row starting with the second; change column 2 in every fourth row starting with the third; change column 3 in every eighth row starting with the fifth; and change every column 1 in every 2^1th row starting with the $(2^{1-}+ 1)$th. The change in the next-higher-numbered row is made whenever none of the lower-numbered rows can be changed according to the above rule. For example, a four-digit binary number is changed thus:

	Column:				Column no.
Row	4	3	2	1	changed
1	0	0	0	0	start
2	0	0	0	1	1
3	0	0	1	1	2
4	0	0	1	0	1
5	0	1	1	0	3
6	0	1	1	1	1
7	0	1	0	1	2
8	0	1	0	0	1
9	1	1	0	0	4
10	1	1	0	1	1
11	1	1	1	1	2
12	1	1	1	0	1
13	1	0	1	0	3
14	1	0	1	1	1
15	1	0	0	1	2
16	1	0	0	0	1

Note, however, that the columns may be numbered in any order, and the starting number may be any binary between 0 and $2^n - 1$. For example:

	Column:				Column no.
Row	2	1	3	4	changed
1	1	0	1	0	start
2	1	1	1	0	1
3	0	1	1	0	2
4	0	0	1	0	1
5	0	0	0	0	3
6	0	1	0	0	1
7	1	1	0	0	2
8	1	0	0	0	1
9	1	0	0	1	4
10	1	1	0	1	1
11	0	1	0	1	2
12	0	0	0	1	1
13	0	0	1	1	3
14	0	1	1	1	1
15	1	1	1	1	2
16	1	0	1	1	1

Roy Moore gives us the recursive construction:

Call a sequence with the required property a "gray sequence." 0, 1 is a "gray sequence" for n = 1, and the illustrated solution is a "gray sequence" for n = 2. We now proceed inductively. Suppose $\alpha_1, \alpha_2, \ldots, \alpha_m$ ($m = 2^n$) is a "gray sequence" for the binary numbers of n digits. Then $0\ \alpha_1, 0\ \alpha_2, \ldots, 0\ \alpha_m, 1\ \alpha_M, 1\alpha_{m-1}, \ldots, 1\alpha_1$ is readily seen to be a "gray sequence" for the binary numbers of n + 1 digits.

Also solved by John F. Chandler, R. Robinson Rowe, Emmet J. Duffy, William J. Butler, Jr., Douglas Szper, Bruce Fleischer, Barry Davis and the proposer, Dave Kaufman.

DEC 5 There are 4n tennis players who wish to play 4n − 1 doubles matches, where n equals any positive integer. How can the matches be arranged so that all players play in every match with the limitation that each player plays with each other player once only and against each other player the same number of times? When n equals one the solution is easy and quite obvious. Is there a general solution or formula or system? Is it limited to perhaps n equals 5 or 6?

Only R. Robinson Rowe responded, and with only a limited solution at that: (Perhaps this will be an NS problem sometime in the 1980s.)

This problem reminds me of the progression at bridge parties. There was a number assigned to each table of four players. After playing four deals, scores were totalled and the winning pair at each table advanced to the next table (or from the first table to the last). Each pair then split and became opponents for the next four deals. Many remarked that the progression was extremely fair, because, it seemed, no two players were partners twice. Trying this system for eight players (n = 2), I developed this tabulation:

Table 1	Table 2
AB CD	EF GH
AE BF	CG DH
AC EG	FH BD
AF CH	DG BE
AG DF	BH CE
AB BS	DE CF
AD EH	BC FG

That is, at the start, A and B were partners against CD. C and D advanced and split. A and B stayed and split. It was convenient to have the second column of Table 1 and the first column of Table 2 advance each time. The system is not automatic. For instance, if BE instead of DG had advanced after the fourth rubber, one or the other would have been partner of A again. But there was an obvious alternative. I haven't the patience nor the computer to try this system for n = 3, 4, etc. Parties often had four or more tables, but for four tables it would take 15 rubbers to complete the test of fairness and we never played that many in the evening. So all I can say is that this system works for n = 2.

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The problem is reminiscent of the Kirkman's Schoolgirl Problem. The original particular set-up with 15 girls in a column of threes was not too difficult, but extension to the general case of 3n girls was so widely analyzed that W. W. Rouse Ball devoted an entire chapter to it in his *Mathematical Recreations and Essays*. The general case of this problem might be equally complicated.

Proposers' Solutions to Speed Problems
M/A SD1 Remembering that 32° F. = 0° C. and that increments are in the ratio of 9 to 5, one step gives 41° F. = 5° C. and the second step, 50° F. = 10° C., which is in the ratio of 5 to 1. Stepping down the same way gives in turn 23° F. = − 5° C., 14° F. = − 10° C., 5° F. = − 15° C., − 4° F. = −20° C. — again in the ratio of 5 to 1. So the daily range was 54° on the Fahrenheit scale and 30° on the Celsius scale. Of course, a more elegant solution would use algebra, starting with − 40° F. = − 40° C.
M/A 2D2 The interest due the first year is (.08) ($20,000) ± (.08) (30x), etc.

Allan J. Gottlieb is Coordinator of Computer Activities and Assistant Professor of Mathematics at York College of the City University of New York; he studied mathematics at M.I.T. (S.B. '67) and Brandeis University. Send problems, solutions, and comments to him at York College, 150-14 Jamaica Avenue, Jamaica, N.Y., 11451.

Salisbury

Continued from p. 14

Before the Arab oil embargo, the United States was committed to an international solution for the problem of Antarctic resources. But since that time, the U.S. agencies with energy responsibilities have begun to lobby for unilateral exploitation of Antarctic wealth. Any such action is believed to be at least a decade away.

It seems likely, in the meantime, that scientists will begin sharing the vast spaces of Antarctica with technologists intent on profiting from its wealth. Because the treaty, as written, ignores resource exploitation, legal authorities say there is little anyone could do if a country such as China moved onto the continent and began to exploit it.

David F. Salisbury is writing for the Christian Science Monitor *from its West Coast office; he is a frequent contributor to the* Review.

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